MODERN PLASTICS

mp

JANUARY 1942

1920 The Hoover vacuum cleaner... *then.*

1942 Utilizing Durez plastics, a famous designer, Mr. Henry Dreyfuss, designs a famous vacuum cleaner—the Hoover.

194-? How will the vacuum cleaner look morrow"? No one can say. But certa the contrast between the 1920 and models invites speculation.

THE FUTURE

is being made today!

WHO ARE the men who must continually look, think and work with an eye to the future?

Two groups of such men are the research staff at Durez and the industrial designers of America.

Regardless of depressions, national emergencies or priorities ... it is the special task of Durez research engineers and chemists to create the materials which ready today's *ideas* for tomorrow's production lines. New formulae, new phenolic molding compounds and new resins are being developed in the laboratory—some have been adopted already for the frontline of defense production.

Under priorities today ... tomorrow they will become the bilge pumps and batter-mixers ... the better brake linings ... the stronger molding resins ... the faster drying and harder surface finishes ... the weather-resistant plywood—the host of products that will be at a premium in the future which lies ahead.

Ever thinking and working to bring better products into our way of living ... America's industrial designers look ahead today's competition. Yet not only do they improve prod *basically*... they also serve manufacturers by adding greater s appeal while incorporating production economies! From t long and hard-won experience they *know* that Durez plas "fit the job"!

If you wish to keep apace with plastics ... a request on y letterhead is all that's needed to bring *Durez Plastics News* to y desk every month.

A MESSAGE FROM HENRY DREYFU

"As for design trends, I think our use of pla so far has only faintly outlined their brilliant sibilities. Plastics have those qualities which the designer's check-list—basic versatility, stre with light weight, obedience to close tolera and mass-production economies. Intelligen search and engineering are opening up ever avenues that lead straight to plastics."

Henry Dreyfu

DUREZ... plastics that fit the job

DUREZ PLASTICS & CHEMICALS, INC. DUREZ 1121 WALCK ROAD, N. TONAWANDA, NEW YO

WHEN MINUTES COUNT *Catalin* SAVES DAYS

★ SHEETS ★ RODS ★ TUBES AND LARGE CASTINGS

MANY an essential part is being turned out from stock Catalin!... On regular machine shop equipment!... At a tremendous saving in time! From the thousands of standard castings on hand, hundreds are being adapted to the imperative needs of the moment in order that days, and weeks of days be saved for production's gain. ★ As it saves... Catalin also serves! Its physical fitness has qualified it to don a uniform. It is strong, chemically resistant, non-inflammable and practically non-water-absorbent. ★ Even special shapes, regardless of size or thickness, can be tooled up for and cast in fractions of the starting time required for molding. Of all plastic materials, Catalin, therefor, offers most to those who are pressed to produce. ★ In addition, a well trained army of Catalin fabricators are in the field and ready to assist as sub-contractors to busy manufacturers. Therefor, whether your problem is one of materials or production, and if the effort is essential to national defense, contact Catalin!

CATALIN CORPORATION • ONE PARK AVENUE • NEW YORK, N.Y.

CAST PHENOLIC RESINS • POLYSTYRENE MOLDING COMPOUNDS
MELAMINE AND PHENOLIC LIQUID RESINS

Yours for the Asking!

This comprehensive book covers completely the methods and equipment required to fabricate Catalin. Design data, physical properties and many other pertinent facts are also covered.

PROTECTION . . . for America

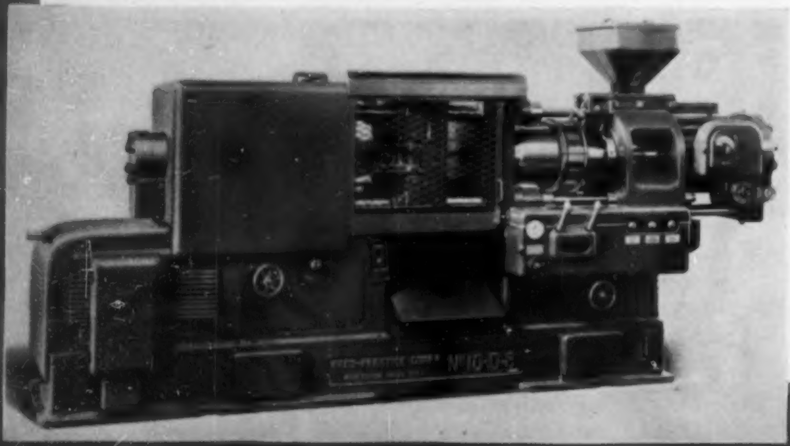
REED-PRENTICE MACHINES

PROVIDE PROTECTION FOR VITAL AIRCRAFT SPARK PLUGS

Here's a case where injection molded plastics play a little-known, yet important role in the defense program. These threaded Tenite shields protect both ends of an aviation spark plug (as shown lower right) during transit to the aircraft plants.

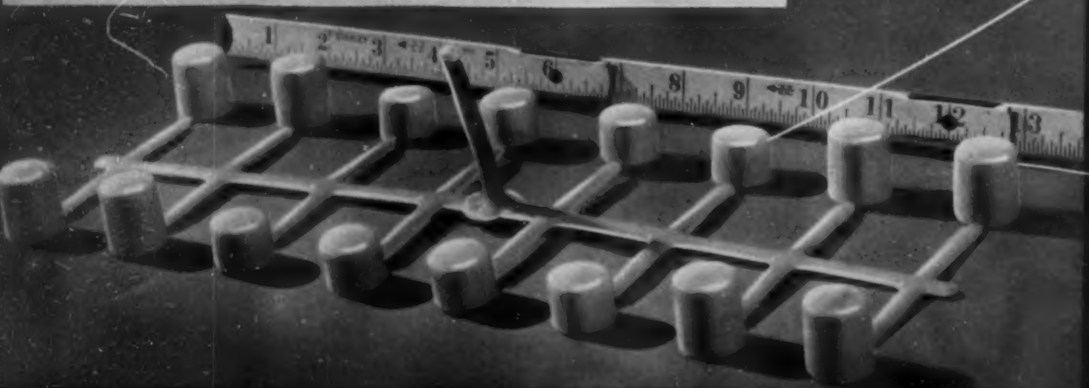
Of course, the primary purpose of these shields is to protect the accurate setting of the points until the plug is actually installed in the airplane motor. They're molded on a Reed-Prentice 6 ounce machine by Peerless Molded Plastics, Inc., Toledo, Ohio, for Champion Spark Plug Co.

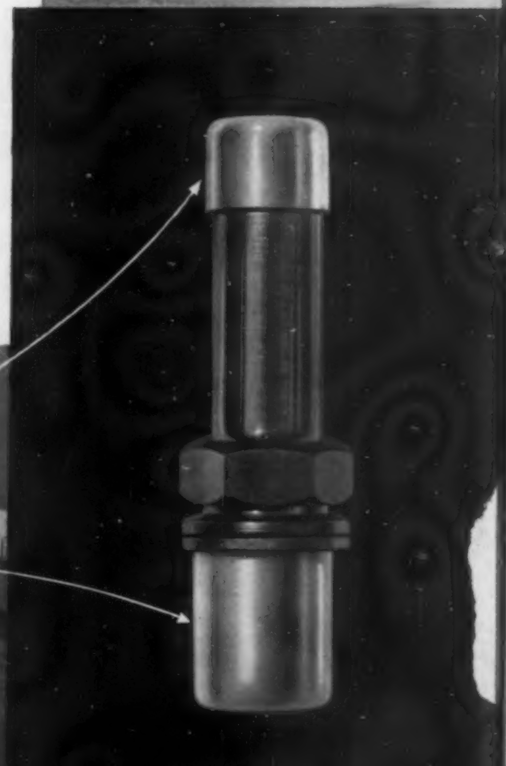
Perhaps you have a possible application that is just as unusual, where injection molded plastics will serve an important purpose, at the same time releasing valuable metals for other defense needs. If you have, be sure to investigate Reed-Prentice equipment—it has what it takes to assure you real outstanding results.



(At left) Reed-Prentice No. 10D-8 oz. Injection Machine. Also available are 4 and 6 ounce sizes.

"Reed-Prentice features covered by Patents Pending"





REED - PRENTICE CORP

WORCESTER, MASS. U.S.A. NEW YORK OFFICE 75 WEST S

CLEVELAND OFFICE — PENTON BLDG. 1213 WEST 3RD. ST.

457 MACHINES IN SUCCESSFUL OPERATION

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modern plastics

JANUARY 1942
VOLUME 19 NUMBER 5

FEBRUARY

With the increasing importance of styrene resins for military uses, particularly in the electrical insulating field, the development of Styramic, a new material for high frequency insulation, is of great interest at this time. A complete description and history of this development will be discussed in an article by T. S. Carswell, Director of Research, and R. M. Hayes, Research Group Leader, of the Monsanto Chemical Co., in our February issue.

The Technical Section will feature an article on diffusion properties of urea plastics in lighting fixtures prepared by R. Bowling Barnes and Charles R. Stock of the Stamford Research Laboratories, American Cyanamid Company.

GENERAL INTEREST

TECHNICAL SECTION

NEWS AND FEATURES

Cover colors this month DEFENSE BLUE and SUNCLAY YELLOW (Created by Textile Color Card Association)

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Madeleine Carroll and Stirling Hayden in Paramount Pictures' current celluloid epic in Technicolor—"Bahama Passage."

Why "Celluloid" is slang for a motion picture

A day never passes without the phrase "a Celluloid epic" appearing in the newspapers and magazines or coming over the air to describe a motion picture film.

In fact, many years ago, we had to instruct our clipping bureau to pass over these references to our trade name "Celluloid" or the bill for clipping would soon look super-colossal.

The reason this phrase has clung so tight is that members of the Celanese Celluloid organization played two fundamental parts in founding the motion picture industry. First, by giving the world the first plastic, Celluloid—which is the base of all commercial film. Second, in 1890, by inventing the process of making Celluloid in continuous lengths or rolls, which is essential for producing a reel of motion pictures.

That was 37 years before we introduced

LUMARITH
REG. U.S. PAT. OFF.

the new era plastic of today.

We cite this case as an everlasting reminder that American inventiveness has a habit of solving problems—including shortages.

Today, Lumarith, the first cellulose acetate plastic, is doing a job in many defense applications—in the air, on the ground and under the ground. Naturally, with this plastic, whose supremacy is unchallenged in many fields, the shortage problem has raised its ugly head.

But with the vigor that got this business and the plastics industry started, we are solving material problems every day.

Which leads us to end on this note—*to be in on the ground floor in plastics developments, keep in touch with Celanese Celluloid.*

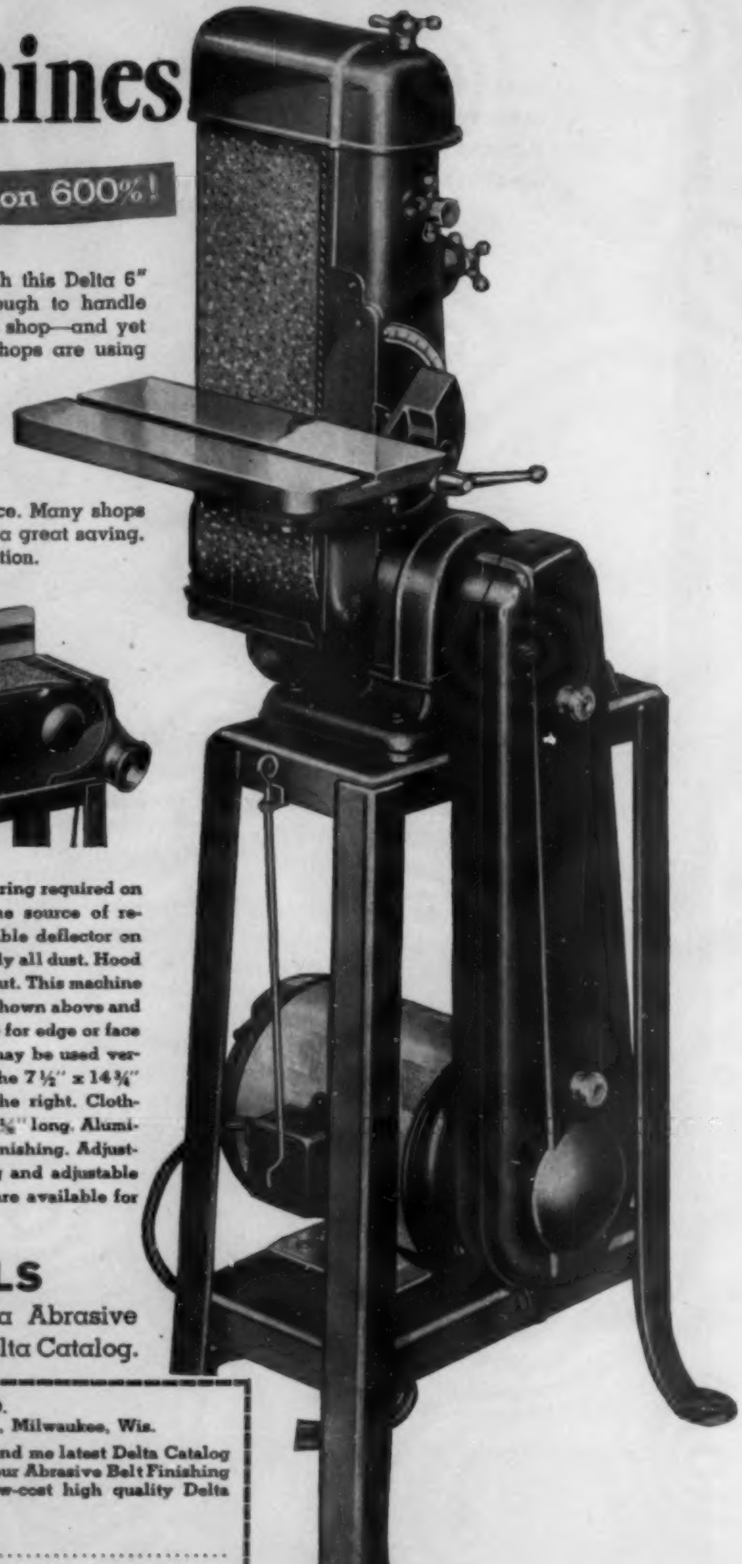
Celanese Celluloid Corporation

Celanese Celluloid Corporation (formerly Celluloid Corporation), 180 Madison Ave., New York City. Sole Producer of Celluloid* (cellulose nitrate), Lumarith* (cellulose acetate), Lumarith Protectoid* (transparent packaging material), H-Scale* (synthetic pearl essence), Lindol* (plasticizer and lubricant additive), Samson* and Safety Samson* Film Bases, and Vimlite* (Flexible health glass). *Trademarks Reg. U. S. Pat. Off.

SAVE MONEY QUICKLY*

with these Low-Cost Abrasive Belt

Finishing Machines

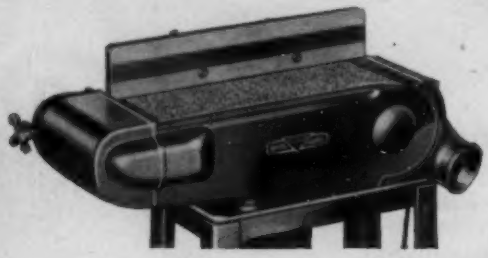


***One manufacturer stepped up production 600%!**

There's a place in your shop to reduce costs and save money with this Delta 6" belt-type Abrasive Finishing Machine. It's heavy and husky enough to handle any of the dozens of sanding and polishing operations around the shop—and yet is portable enough to be moved just where it is needed. Many shops are using this machine for polishing and sizing metal parts (*in one plant making precision instruments, production was increased 600% by the use of this Delta machine).

Die-casters, also, use it as a finishing and polishing machine, with a great saving in power cost over larger machines. For finishing, finning and surfacing plastic parts, it has found wide acceptance. Many shops have used combinations of this unit to make up special machines at a great saving. It is adaptable for practically any small industrial finishing operation.

HAS MANY UNUSUAL FEATURES



Completely Enclosed— Thoroughly Guarded

Only the portion of the belt that is being used is open, the ends and bottom of the belt, as well as the drums, being completely covered. The guard covering the end drum may be removed in a moment, for use in finishing long materials, or for curved work. This complete enclosure also increases the efficiency of the dust removal system.

Completely Ball-Bearing Equipped

Double-seal bearings, lubricated at the factory for life. No rubber covering required on drums, thus eliminating one source of replacement expense. Adjustable deflector on drum hood catches practically all dust. Hood is provided with suction spout. This machine may be set horizontally, as shown above and equipped with a wood fence for edge or face sanding, if required. Or it may be used vertically, in connection with the 7½" x 14¾" tilting table as shown to the right. Cloth-backed belts, 6" wide by 48⅛" long. Aluminum-oxide belts for metal finishing. Adjustable fence for edge sanding and adjustable back stop for flat sanding are available for use in horizontal position.

SEND FOR FULL DETAILS

For complete specifications and low prices on Delta Abrasive Belt Finishing Machine send coupon below for latest Delta Catalog.

DELTA MILWAUKEE

THE DELTA MFG. CO.
623-A E. Vienna Ave., Milwaukee, Wis.

Gentlemen: Please send me latest Delta Catalog giving full details on your Abrasive Belt Finishing Machine and other low-cost high quality Delta machines.

Name..

Address.......................................

Who said

GASOLINE AND PLASTICS

don't mix!

NEW PLASTIC PRODUCTS NOW POSSIBLE WITH SARAN

These applications for airplanes, automobiles or motor boats require resistance to gasoline and oil.

Carburetor Parts • Gasoline Gauge Floats Gasoline Lines (tubing) • Gaskets, Packing Rings • Pistons and Gears (for pumps) Gas Tank Lids • Brake Lines • Battery Cases • Flow Meters for Airplanes Woven SARAN Mesh for Gas Hoses Auxiliary Tanks and Bowls Filter Screens and Parts

CHEMICALLY RESISTANT SARAN POINTS TO SAVING OF STRATEGIC METALS

SARAN* for gasoline lines! SARAN for carburetors! SARAN in place of strategic metal tubing! That's the news American industry is hearing today as Dow's remarkable thermoplastic material opens whole new fields of plastic development.

Already, progressive manufacturers are working with SARAN for fuel lines, gas gauge floats and battery cases. Yet, this is only a beginning, for SARAN with its amazing resistance to gasoline and oil can be specified for applications heretofore banned to plastic materials. Pistons and gears for fuel and oil line systems, gaskets and packing rings—on and on the list goes for airplane, automobile and many other types of motors.

These new and diversified plastic applications are made possible by SARAN'S unique physical properties. Resulting characteristics of toughness . . . flexibility . . . durability . . . and remarkable resistance to the destructive action of chemicals mark SARAN for plastic products where service requirements are unusually severe.

The use of SARAN is growing with great rapidity and will no doubt continue to expand as the imagination of progressive designers and manufacturers explores the seemingly inexhaustible possibilities. Present abnormal conditions naturally affect the availability of this material. Nevertheless, Dow is bending every effort to satisfy all needs as they arise. For complete information, write to the Plastics Sales Division.

*Trade Mark Reg. U.S. Pat. Off.

SARAN

THE CHEMICALLY RESISTANT PLASTIC

OTHER DOW PLASTICS

★ STYRON ★ ETHOCEL

★ ETHOCEL SHEETING

DOW

PRODUCTS OF CHEMICAL PROGRESS

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York, Chicago, St. Louis, San Francisco, Seattle, Los Angeles, Houston

PLASTICS for

Zenith Plastics, Inc. located in Cleveland, Ohio, are performing this outstanding job with a battery of four H-P-M Injection Molding Presses.

Above—SWEEPER ENDS (tank type) 6½ ounces: 7" dia.: 5" deep.

Below—MOTOR HOUSING. 8 ounces; 8½" long; 5½" wide; 5" deep.

Left—UPHOLSTERY SWEEPER NOZZLE 1½ ounces; 5" wide; 3½" long.

Right—UPHOLSTERY SWEEPER NOZZLE 2 ounces; 6" wide: 4¾" long.

ALUMINUM

Vacuum Cleaner Parts Molded with H-P-M PLASTIC INJECTION MOLDING PRESSES

. . . Save 100,000 Pounds of Aluminum Per Month for Vital Defense Production

HPM

This enormous saving of vital metal for Defense is matched by the important production economies of H-P-M All-Hydraulic Injection Molding Presses for every plastic molder.

THE HYDRAULIC PRESS MFG. COMPANY
Mount Gilead, Ohio, U.S.A.

District Sales Offices: New York, Syracuse, Detroit and Chicago
Representatives in Principal Cities

Above—HAND CLEANER NOZZLE. 6½ ounces; 6½" wide; 2¾" deep. BACK PLATE: 1 ounce; 5½" long; 3¾" wide; ¾" deep.

Left — UPHOLSTERY SWEEPER NOZZLE 1½ ounces; 5" wide; 3½" long.

Below— MOTOR HOUSING 8 ounces; 8¼" long; 6" wide; 4¾" deep.

H-P-M All-Hydraulic Injection Molding Presses are available in seven standard sizes from 2 to 36 ounce capacities. Complete specifications will be sent upon request.

Below—SWIVEL TUBES. 2½ ounces; each— 1½" dia., 3" long.

Above FLOOR NOZZLE. 6 ounces; 12" wide; 2½" long; 2½" deep.

POINTING TOWARD THE FUTURE

NOW is the time to think of the future. Think of your product in terms of future sales. Consider what changes can be made in its styling and design to decrease weight, to add beautiful and permanent color, to give it "eye appeal and buy appeal." We will gladly cooperate with you in investigating the possibility of your using PLASTICS to advantage.

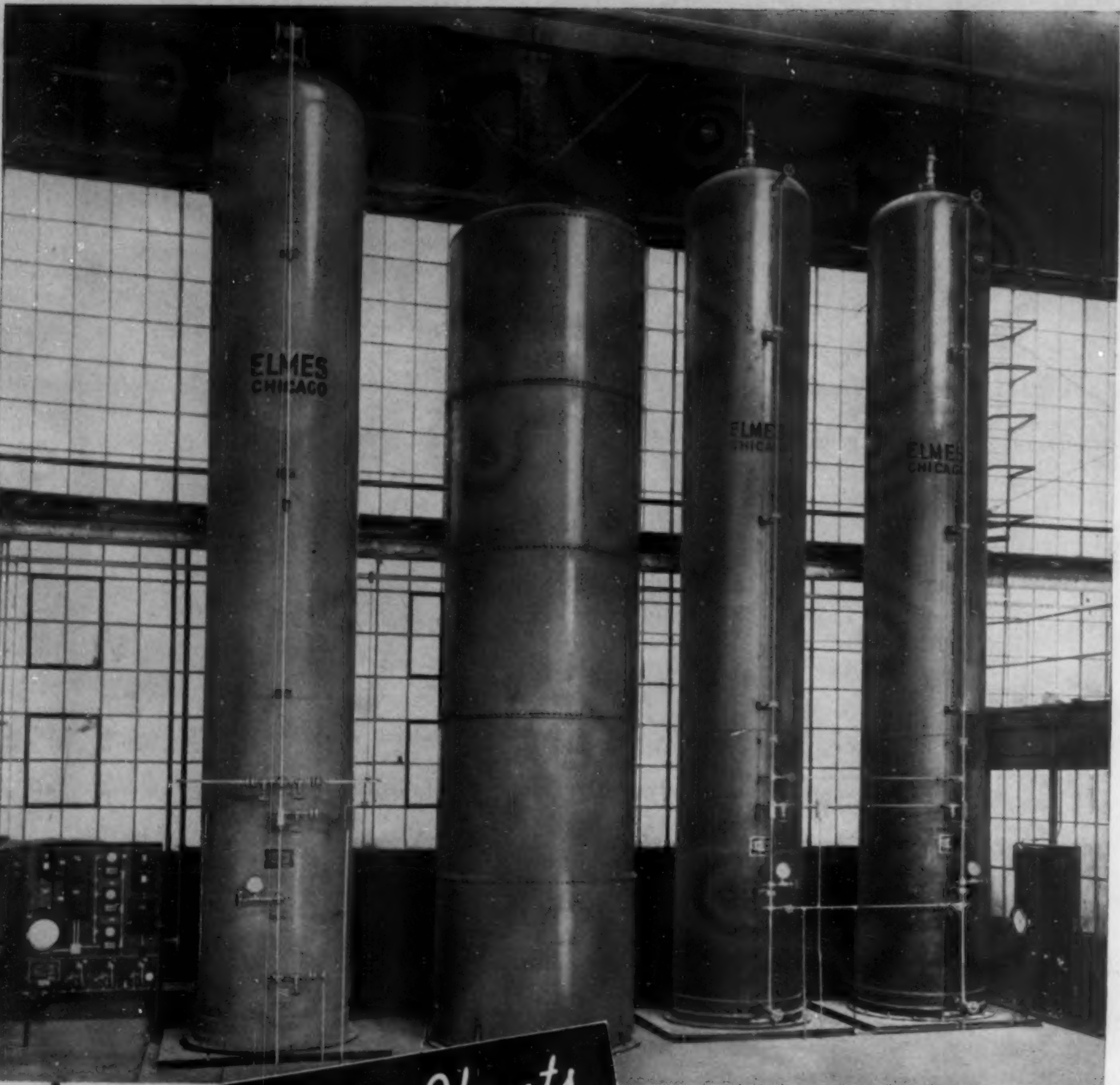
We, too, are looking to the future by constantly improving our equipment and carefully testing plastic materials to determine which are best for various types of moldings.

PLASTICS, like any other material, have certain limitations and cannot be used satisfactorily for certain purposes. We'll be glad to tell you truthfully what they can and will do for you.

The above Thermostat Housings molded for The Crise Electric Company of Columbus, Ohio under their patents are outstanding examples of the delicate precision molding we are qualified to handle. These pieces are molded in Polystyrene.

KILGORE

Plastic Division of the Kilgore Mfg. Co., Westerville, Ohio


ELMES
CHICAGO

Molded Thermoplastics meet the demands of industry for products formerly made of metals. These injection molded chime housings replace metal, add beauty and color and effect savings in production by elimination of costly finishing operations. Our engineers may be able to help you. Ask for information.

Your signature on your letterhead brings you a copy of this catalog containing data and illustrations of molded thermoplastics.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Saran and Other Thermoplastic Materials.

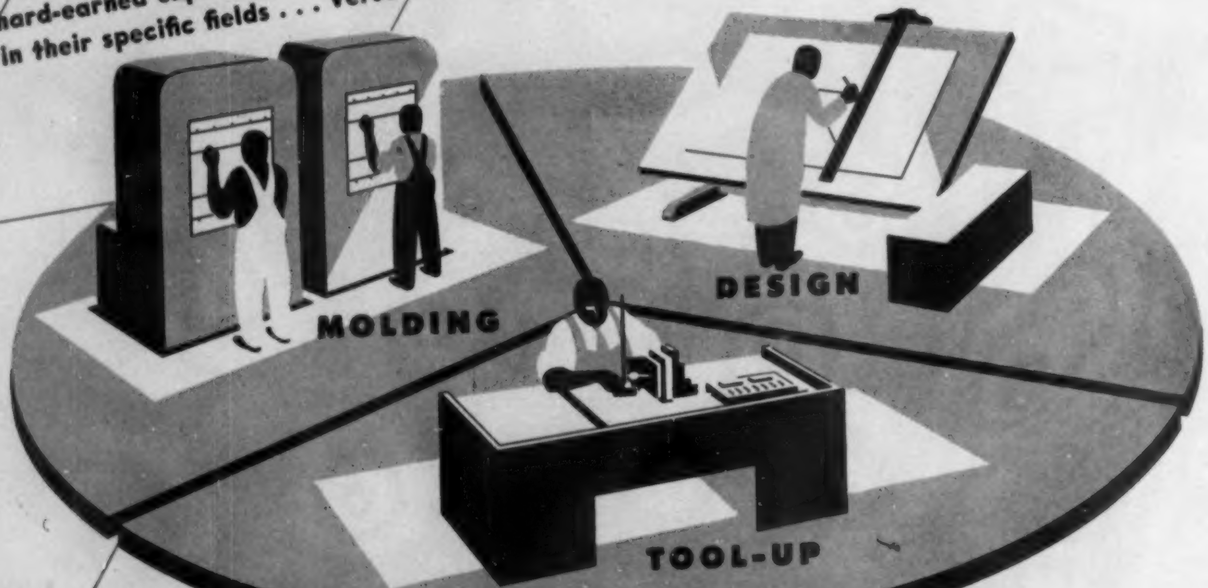
312 West Van Buren Street - - - - Chicago, Illinois

PRESENTING THE KURZ • KASCH

"Plastics Round-Table"

● No one man, no one department, can successfully tackle a plastics problem. Kurz-Kasch recognizes this simple fact and puts the skills of several specialists to work on your problem: specialists in design, material selection, tooling, and production. This conference method of getting the most out of plastics quickly and at the lowest cost to you, we call the Kurz-Kasch Plastics Round-table. It brings the many phases of your specific problem under one responsibility, yet calls upon the hard-earned experience of many men, expert in their specific fields . . . Versatile materials in peace, plastics have become vital materials in war. Daily they fill new jobs, help to make machines more serviceable, simplify designs, conserve our resources of metals and other precious materials.

In the face of a national emergency, we ask you to help us and all other molders restrict the use of plastics to applications essential to interests of our national welfare. And through the Plastics Round-table, we place at your service men, machines, and materials that can and will help plastics go the furthest and count the most in the big job that's ahead.



The Kurz-Kasch Plastics Round-table is a group of specialists, all of whose skills in design, materials selection, tool-up, and production, are applied to your specific problem. This "conference" method has helped hundreds of manufacturers get sounder, more serviceable products at substantial savings in production.

CALL KURZ•KASCH

Kurz-Kasch, Inc., 1417 South Broadway, Dayton, Ohio • Branch Sales Offices: New York, Chicago, Detroit, Los Angeles, Dallas, St. Louis, Toronto, Canada • Export Office: 89 Broad Street, New York City.

Injection-molded by Salz Brothers Inc., New York, from a molding powder based on Hercules Cellulose Acetate Flake.

A REMARKABLE COMBINATION OF ADVANTAGES

These pens look as though they'd cost many times more than twenty-five cents. Cellulose acetate plastic gives them a look of quality that makes this modest price seem impossible.

BY RE-STYLING hundreds of other products in colorful, practical cellulose acetate, manufacturers are adding charm and sales appeal, as well as strength and durability, to items as varied as cookie cutters and traffic buttons, or parts of machines and handles for tools.

This re-styling often is prompted by shortages of other materials; in such cases, the versatility of cellulose acetate is noteworthy.

CELLULOSE ACETATE PLASTIC is tough and resistant to impact even in thin sections. It is easy to mold on the fastest automatic machines. Scrap can be re-worked. There are practically no finishing costs—color is built right into the plastic; and the wide range of colors is a joy to the designer.

IMPORTANT CONTRIBUTIONS have been made by Hercules to the high quality and versatility of cellulose acetate. To get the benefit of these advantages in your finished plastics, ask your molder to use a compound made with Hercules Cellulose Acetate flake. Write Department MP-1 for literature.

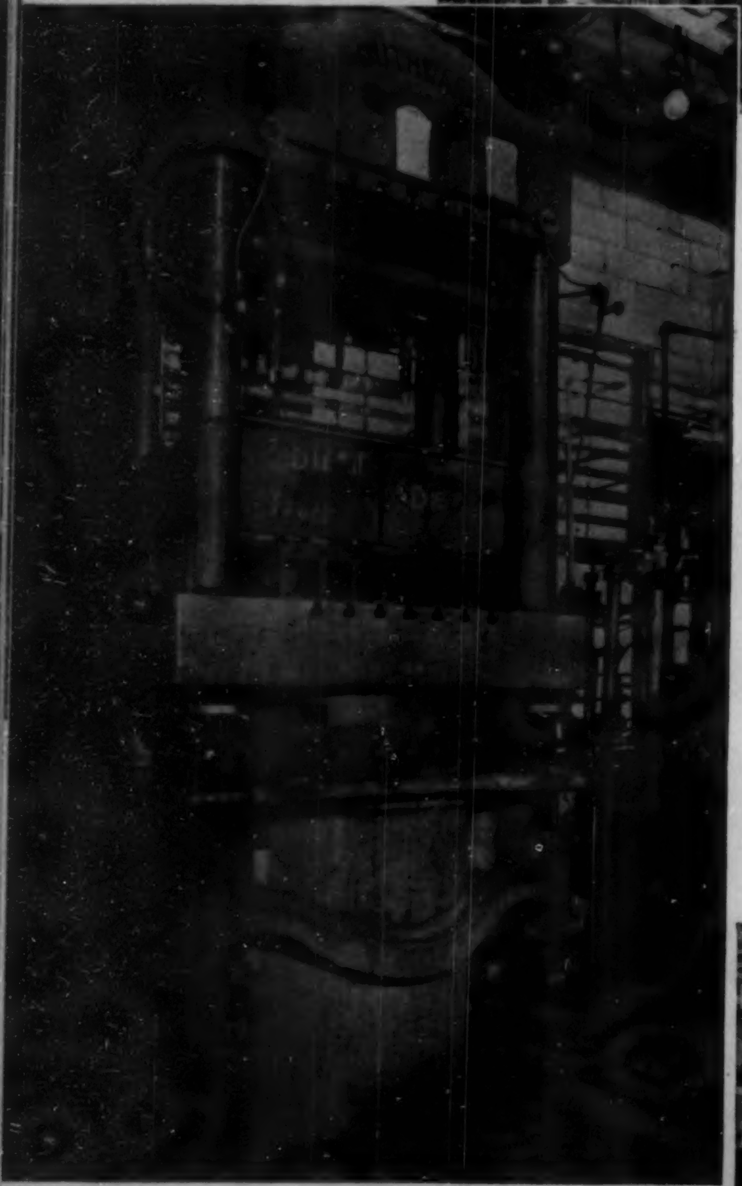
HERCULES CELLULOSE ACETATE

HERCULES POWDER COMPANY · WILMINGTON, DELAWARE
Incorporated

DDD-44

LET'S WORK TOGETHER FOR DEFENSE PRODUCTION!

212,000 Sq. Ft. of Floor Space



We Can Produce the Molded Plastics Parts in Any Quantity—Any Specification—On Time

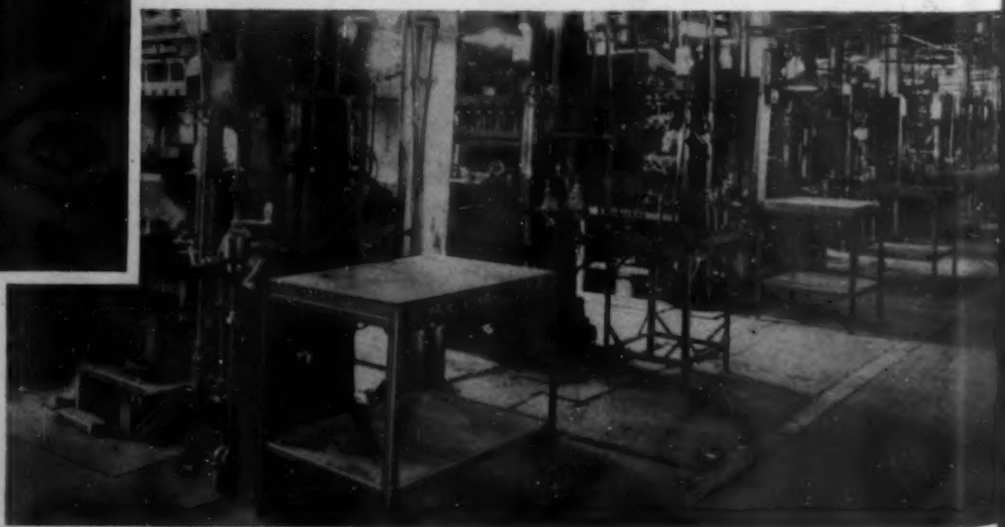
● If you want a reliable, reputable source of supply for your molded plastics parts for defense production, General Industries merits your first consideration.

We have the plant, 212,000 square feet of capacity, enabling us to handle the largest quantities with ease.

We have the machines, modern and highly efficient, to turn out articles of any shape and any size, even the largest. All operations, including making the molds, are done in our own plant.

We have the men, engineers and workmen, long skilled in producing molded plastics parts of all kinds and descriptions.

We have the experience in producing molded plastics parts, often in immense quantities, for manufacturers of America's best known automobiles, electric appliances, motors, radios, phonographs and other products where the highest degrees of accuracy, finish and appearance are primary requisites.



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The GENERAL INDUSTRIES Co.

MOLDED PLASTICS DIVISION . . . ELYRIA, OHIO

BETTER *Ears* FOR THE 'COBRAS

...They weigh less, hear better— thanks to LUSTRON!

Picture an R. A. F. squadron of American-built Bell-Airacobras on the prowl. One minute they're sweeping through sub-zero temperatures at 20,000 feet... the next they may be diving at 400 miles an hour to strafe ground objectives from a bare 20 feet. Over their radios crackle orders, warnings, calls for help, welding the separate planes and pilots into a single, deadly fighting team.

That's the kind of punishment an Airacobra's slim-metal radio mast and its sturdy base of molded Lustron, Monsanto's polystyrene must take. That's how important these 14 ounces of plastic are to the life and success of an Airacobra squadron.

Thanks to the excellent electrical properties of Lustron, these antenna bases have helped reduce static and improve reception. Skillful design and the inherent lightness of Lustron have made it possible to cut weight without sacrifice of strength. Thus the 'cobra's ears weigh less, hear better!

For this excellent use of plastics in the cause of freedom, the Bell Aircraft Company and the Erie Resistor Corporation, molders of the antenna bases, were given a top award in the Sixth Annual Modern Plastics Competition... But here's an even more telling tribute to the progress of American electrical manufacturers in the use of plastics: radio equipment salvaged from some of the most recent Messerschmitts has a relatively low range, *weighs twice as much* as American equipment—because the German sets still make extensive use of ceramic insulation instead of plastics! Monsanto Chemical Company, Plastics Division, Springfield, Massachusetts.

The Family of Six Monsanto Plastics

(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)

LUSTRON (polystyrene) • OPALON (cast phenolic resin)
FIBESTOS (cellulose acetate) • NITRON (cellulose nitrate)
SAFLEX (vinyl acetal) • RESINOX (phenolic compounds)

Sheets • Rods • Tubes • Molding Compounds • Castings
Vuepak Rigid Transparent Packaging Materials

MONSANTO PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

Ask Columbian about

REINFORCED PLASTICS

using

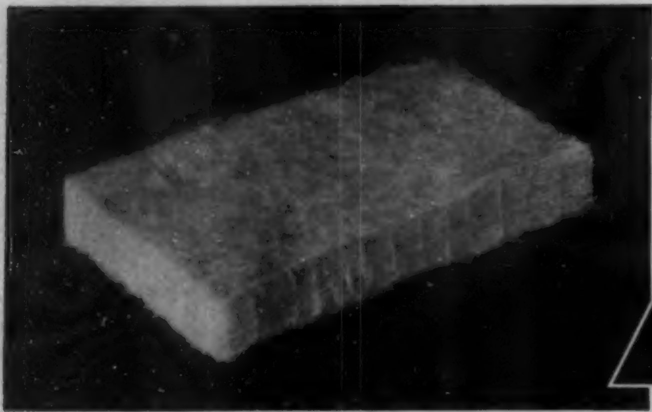
CO-RO-FELT

Columbian High Impact Filler

and

CO-RO-LITE

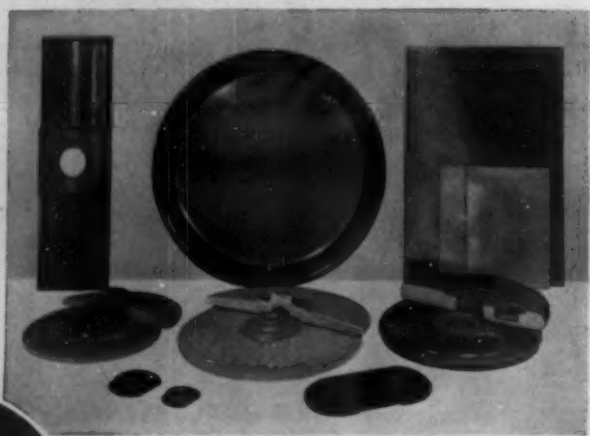
Resin Impregnated Co-Ro-Felt
— ready to mold



Consolidated mass of fibres (Co-Ro-Felt) prior to application of resin

A balanced assembly of Co-Ro-Lite prepared for molding bobbin head

A few of the products now being made from our fillers



The Columbian Rope Company, this country's leading Cordage manufacturers, in their Allied Products Division, are in production on these two outstanding High Impact fillers.

The hard and soft fibres, used for centuries for making strong, durable ropes and wrapping twines have, after several years of research and experimentation, been utilized with complete success as a reinforcing filler in plastics.

In the "Co-Ro-Felt" and "Co-Ro-Lite" processes of the Company, the fillers are used in long stapled length, giving extreme toughness, high impact and shock resistant properties. Both high and low densities are possible in the same molded article by a predetermined assembling of filler sections.

PATENT NO. 2,249,888
Other Patents Pending

ALLIED PRODUCTS DIVISION

COLUMBIAN ROPE COMPANY

400-10 Genesee St., **Auburn, N. Y.** "*The Cordage City*"

NO molder can work MIRACLES!

ON-OFF, ON-OFF, ON-OFF with swift clock-like precision, closures of molded Beetle* in bright identifying colors speed from production lines.

Today's demands for speed and more speed are being met by the plastics industry!

The load of defense production suddenly thrown upon material suppliers and molders alike *has* caused some annoying delays. And there have been criticisms and complaints—many of them *unjustly placed on the molder.*

The facts are these: 1—Both molders *and* material suppliers increased their production facilities in anticipation of much greater demand for plastics! 2—While there is as yet no shortage in the *plastics industry's capacity* to produce sufficient materials for all, acute shortages in certain chemicals that are essential raw materials have resulted in bottlenecks which were beyond the industry's control.

If you are using Cyanamid Plastics—Beetle or Melmac*—or are planning their use *for the requirements of the defense program,* the necessary priority ratings will assist you in obtaining prompt, dependable deliveries.

And remember that while no molder can work miracles, he can be of invaluable assistance to you in your use of plastics—*IF* you give him full information and cooperation in anticipating and working out your requirements.

*Reg. U. S. Pat. Off.

AMERICAN CYANAMID COMPANY
PLASTICS DIVISION
30 ROCKEFELLER PLAZA • NEW YORK, N. Y.

If you are considering plastics for defense work and want information on the characteristics of Beetle or Melmac Molding Materials for lighting, buttons, electrical devices and similar products, write for this free manual. It contains a wealth of helpful information.

Beetle

Portrait of an industry

A survey of the plastics industry describes its position at the onset of World War II

"REMEMBER Pearl Harbor" is the watchword of America at war. Like its predecessors "Remember the Alamo" and "Remember the *Maine*," it calls the country to action against treacherous and unprovoked attack. But Pearl Harbor will have another meaning to the historians who will chronicle our times. To them it will be America's Dunkirk: the end of one phase of our thoughts and actions; the place where we halted and gravely considered our position; the point at which we straightened up and faced the future with resolution and with courage.

The events at Pearl Harbor occurred at the year end, when U. S. business was in the process of closing its books for 1941, and hence able to take stock of its position as America moved from the defense program into the war program. With no claim to prophetic foresight, MODERN PLASTICS in November sent to all material suppliers, machinery manufacturers, molders, laminators, extruders, fabricators and a few prominent industrialists a short questionnaire with the purpose of discovering how the plastics industry had weathered a difficult twelve months, and how it expected to fare in the year ahead. Despite the fact that plastics men have been questionnaired to death in the course of the defense program, their response was most gratifying. In the belief that its readers will be interested in knowing just where the industry stands as we enter the war, MODERN PLASTICS presents in these pages a condensed summary of the replies it received.

Taken collectively, the answers indicate that the industry has recognized the sources of its 1941 difficulties and is settling into it new stride with a minimum of hysteria. Chemical manufacturers, material suppliers, equipment producers, molders and fabricators all appreciate the advantages to the industry as a whole of working in concert. All realize that there will be shortages in raw materials—some serious and protracted; others intermittent and not of great consequence. Everyone is agreed that war requirements should be met first, and that what materials remain for civilian use should be distributed economically and equitably.

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Records for results

The necessity for intelligent wartime cooperation between the Government and business is unusually apparent to one who was associated with the former during the recent period of national preparedness. During the five months I spent in Washington with the Plastics Division of OPM, I had the opportunity of studying the problems of the plastics industry as they concerned the defense program. Since I left Washington, I have had time to review much of the information I gathered there, classify it and draw some conclusions which may be of interest to the industry.

A scarcity of raw materials is an uncommon experience for plastics men, who for the first time since World War I began to feel the pinch last year. It is only natural that this shortage should cause some confusion in the industry. Neither is it surprising that a comparatively young business should not have all its records in such statistical form that they may be presented promptly to OPM in order that available materials can be allocated equitably.

Many of the larger and older industries were, of course, able to meet their materials problems in a comparatively orderly manner. By this I mean that, when the time arrived for allocating materials on a basis of reduced civilian use of those necessary for defense, they were able to present complete industrial records to the Government. On the basis of these data, officials in charge could compute what percentage of normal supplies of materials must be diverted to the war program; what civilian needs could still be met either on a pre-war or on a reduced basis; and what nonessentials were to be eliminated entirely from production schedules.

You of the plastics industry should bear in mind that, although the Government is ready and willing to assist you in your production difficulties, it cannot solve your industrial problems by some occult system of divination. All solutions must be based on actual facts and figures which only you can supply.

For this reason I am appealing to you to get your houses and records in order. Problems common to all of you should be presented to the proper authorities in Washington by committees authorized to speak for the industry as a whole. Individual difficulties arising from the emergency may be discussed separately and a ruling obtained. Again, let me remind you that you are doing yourselves a disservice if you do not have your statistical records in order, so that Government agencies may have accurate information on which to base their decisions.

We hear a great deal these days about national unity, and about the catastrophic results of failure to present a common front to the enemies of democracy. In the conflict ahead, the United States is relying on the man at the machine no less than on the man with the gun. If American industry is to function as a productive whole, each unit which goes to make it up must have an intelligent, coordinated program of its own. And to carry out that program, it must have materials to work with. These materials you will be able to secure if you will get together and give the Government a coherent, well-documented statement of your needs.

L. T. Barnette

Editor

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In the gigantic task which confronts America today of converting all production capacity into a machine for victory, the plastics industry is an important part of the nation's mobilization scheme. That this fact has been recognized within the industry, by Government agencies, and by major producers of such materiel as aircraft and motorized transport, is evident in the individual letters presented on these pages. Each of these writers, eminent in his field, by expressing his views of plastics activities makes an important contribution toward clarifying the industry's position today.

The principal objectives which material manufacturers are attempting to reach are outlined below by Arnold E. Pitcher, of E. I. du Pont de Nemours & Co., Inc., who is President of the Plastics Materials Manufacturers' Association.

To the Editor, Modern Plastics:

At the beginning of the present emergency, it became at once apparent that the productive facilities of the plastics materials manufacturers were inadequate to meet the defense requirements of the Government and the demands of customers fabricating plastics for civilian use.

Confronted with this condition, the material manufacturers had three objectives in mind:

First, to cooperate unreservedly with the Government in their defense program and if necessary place the entire technical and manufacturing facilities of the industry at their disposal.

Second, to the extent these facilities are not required for defense, devote them to serving the best interests of customers fabricating plastics for civilian needs in cooperation with the Office of Production Management.

Third, in so far as possible without interfering with the defense activities, continue research with the hope of developing new types of plastics which will cushion the effects of the post-war era and strengthen the foundation of the industry for later progress.

In carrying out the first objective, defense requirements have of course had first call on productive capacity. Next, and very importantly, most manufacturers of plastics have assigned a technical force to the task of working intensively with the Government on new developments for defense. Out of these efforts there have already resulted many useful developments in utilizing plastics in the defense program and a substantial demand for a variety of plastics. As time goes on and as the industry's cooperation with the Government continues, further important developments may be expected in the use of plastics for defense.

In following up our second objective, the material manufacturers were prompt to establish a cooperative relationship with the Office of Production Management when the first acute shortages of plastics developed, and aided in assembling information as a basis for outlining the mandatory priority which was issued on the formaldehyde type of plastics. The relationship thus established has continued harmoniously ever since.

It should be kept in mind that at the inception of the present emergency, our industry was in a state of rapid growth. As a result of the intensive research and development work which had been done in the preceding years, the use of various types of plastics had been greatly expanded and the demand increased until the productive capacity was in many instances insufficient to meet the requirements of the trade. When, in the early stages of the defense program, it was found necessary to restrict the use of many metals required in defense industries, plastics were called upon to serve in widely extended fields. This service has not only helped to supply an emergency need but also demonstrated the usefulness of plastics and plastic molding processes for many purposes not previously recognized. The material manufacturers put forth every effort to increase their manufacturing facilities to the extent that equipment was available and, as a matter of fact, did substantially increase the output to a point where the production of all types of plastics for 1941 will establish a record far beyond any previous output in the history of the industry.

Notwithstanding this, when the added requirements for defense were superimposed on the already expanded demands for civilian use, the total capacity of the industry proved to be entirely inadequate. The scarcity of certain strategic chemicals used extensively in ammunition as well as in plastics further curtailed production. This situation resulted in the issuance by the Office of Production Management of a mandatory priority on the formaldehyde group of plastics, as the most acute shortage existed in this field.

Following this, further shortages developed in the various types of thermoplastic materials, and within the past few weeks OPM officials have been cooperating with the industry in assembling information as a basis for issuing a mandatory priority on this group.

The Plastics Materials Manufacturers' Association, the Society of the Plastics Industry and the Plastics Molders' Committee have been working shoulder to shoulder in this activity to acquaint the industry in general with the situation confronting them and to provide an opportunity for individual fabricators of plastics to express their views directly or indirectly to OPM officials. The Society of the Plastics Industry and the Plastics Molders' Committee have done an outstanding job in this effort. They have sponsored several meetings which have been largely attended. With the splendid cooperation from OPM executives, detailed discussions have taken place concerning conditions and problems in the industry and Government and the bearing they may have on the mandatory order now in the process of preparation. This order will in all probability be issued within the next few weeks.

The material manufacturers regret sincerely the hardship which will be imposed upon certain fabricators of plastics in the so-called luxury group but in the "all-out" war effort in which we are now engaged, it is inevitable that the manufacture of many nonessential items must be discontinued, not only in plastics but in other lines as well.

As for our third objective, many of the outstanding chemical research departments of the country are continuing industriously their efforts to develop new types of plastics. The experience gained in the last few years in the development of some of the outstanding new plastics now on the market and knowledge obtained in the experimental work being conducted on defense activities will help materially in solving the problems involved in further new developments for the post-war period. Unless interrupted by defense requirements, this work will go on.

Thus is our industry readjusting itself to meet war conditions. As time goes on and the demands on the industry increase, the material manufacturers will continue their best efforts to meet the objectives outlined in the beginning of this statement.

A. E. Pitcher

Raw Materials

Materials of all kinds, whether they be metals, textiles, chemicals or plastics, cannot be reviewed without mentioning the enormous quantities required for the war program. At present it is estimated that only some 20 percent of the nation's production is going into war material; but even with so small a percentage diverted, certain materials have for some time been critical. By the end of 1942, it is estimated that this 20 percent will be doubled. Consequently, we can assume that materials shortages will continue to increase. Government agencies have endeavored to anticipate and provide for the additional raw materials required for war, but it has been difficult to keep production parallel with demands, especially when there is a shortage of plants and facilities. Less uniformity in allocation of materials for specific uses and consequent disruption of production schedules can therefore be anticipated in 1942, although such conditions may not be expected to continue indefinitely.

Thermosetting materials

In the thermosetting type of plastics, shortages began to appear early in 1941. As production for defense increased in volume, it was found necessary to place first formaldehyde[1] and then the phenols[2] on a strict mandatory basis. While provision has been made to increase the production of both of these chemicals, it now appears that the anticipated ware requirements will absorb all such increases, and may even exceed them. This means that the outlook for 1942 does not show increases in over-all production of thermosetting materials above the 1941 figure. Should new production facilities due this year be delayed for any reason, some of the present supply of the chemicals must be diverted to war, thus actually reducing the raw materials poundage in 1942. There is an increasing military demand for phenolic resinous protective coatings which, if it continues to expand, will divert supplies of phenolics which might otherwise go into the manufacture of molding compositions.

In the past, the industry has relied on the importation of important quantities of the cresylic acids for laminating and related types of work. The price of these imported materials has been constantly increasing and has now reached a point where they are no longer attractive to material suppliers. The laminators themselves may import some of these materials direct for their own use. Should these imports be reduced or cut off, however, some phenols may be diverted to this type of work, causing a further shortage in molding compositions.

Development of extenders

In view of this situation, it is only natural that a great deal of effort is being put forth to develop and utilize suitable nonstrategic and extender materials (see "Plastics from agricultural by-products," on page 70 of the December issue of MODERN PLASTICS). Lignin, for example, due to its low cost and availability, may become important as war demands increase. Plastic lignin pulp can be ground and plasticized to produce either a thermoplastic or a thermosetting molding material. Considerable experimental and development work has been done to create a lignin molding composition that will compare favorably with well-known phenolic formulations. When a relatively small percentage of phenolic resin is used as a plasticizer for ground lignin pulp, the molded results yield approximately the same physical properties as would ordinarily be obtained from phenolic molding composition containing 40 to 50 percent of phenolic resins. A somewhat longer molding cycle may be required with the lignin formulation, but in view of the lower costs of the lignin ground pulp the cost per finished molded piece may compare favorably with that of a finished phenolic piece.

Paper sheets made from lignin plastic pulp can be molded by the regular laminating procedure with good results. However,

[1] MODERN PLASTICS *19*, No. 1, Sept. 1941, insert p. 44–45.
[2] MODERN PLASTICS *19*, No. 4, Dec. 1941, insert p. 34–35.

Ronald Kinnear, President and Treasurer of the Niagara Insul-Bake Specialty Co., Inc., also President of the Society of the Plastics Industry surveys the industry as follows.—ED.

To the Editor, Modern Plastics:

Plastics are not immune to the innumerable complex problems of defense which affect industry. The American plastics company, whether material manufacturer, molder or fabricator, doesn't exist which hasn't in one way or another felt the impact or strain of the defense load. Realizing that many chemicals required for manufacturing plastics are also essential for many vital war materials and with the added demands of lease-lend commitments, it is nearly a miracle that our industry hasn't been more seriously dislocated.

Within recent months the industry has seen a host of direct defense and many semi-direct defense applications develop. Some plastics plants are running nearly 90 percent on defense work, others 65 to 75 percent and still others doing more or less by varying degrees. Aside from the extensive use of thermoplastics in transparent form for aircraft enclosures and some molded gas mask parts and the use of vinyl polymers for electric cable insulation, the thermosetting resinous compounds have been most extensively developed for war purposes, principally because of their physical properties. The active manner in which plastics firms have approached the defense problem is a credit to the management and the supporting personnel of the companies involved. There are often heartaches and heartbreaks in solving the problems encountered.

★ The industry's first concern has been and continues to be defense. It has already shouldered a sizable defense burden. It is prepared to and is capable of doing even more. ★

★ Many companies have been seriously rocked because of material shortages for commercial business. The effect of OPM phenol and formaldehyde orders are only too well known in many cases. ★ If the amended OPM M-25 formaldehyde order fufills the anticipated relief expected of the ruling, the industry will be helped some. If phenol now being diverted to less essential purposes were made available for plastics, the industry would be greatly relieved.

All organizations of the thermoplastics branch of the industry have a decided interest in the proposed OPM general preference order which will regulate the supplies of these materials. Based upon the operation of the Government orders regulating thermosetting materials, my feeling is that it would be highly preferable and more desirable to have a scaling down or a restricted distribution of raw materials in all civilian classifications rather than an arbitrary restriction to particular trades. This method will at least permit operators to keep their organizations intact, and permit them to exercise their rights to live.

Troubled as these days are, our industry is creditably demonstrating its ability to take its place among those which have been longer established in handling the war assignment. If the distribution of materials available for civilian purposes is properly handled with even only "half a loaf" here and there, generally speaking, the survival value of most companies is good.

Production from several of the new material plants under construction would be a boom to the industry. It remains to be seen how much of the material they produce will be available to our industry. Added plant capacity would indeed be a benefit. We all realize we (the arsenal of democracy) have a war to win.

Ronald Kinnear

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Arthur E. Peterson is Chief of the Organics Section, Chemicals and Allied Products Branch, OPM, and as such is in charge of the allocation of raw materials for plastics manufacture.—ED.

To the Editor, Modern Plastics:

Now that war has finally engulfed us there must be a new emphasis in our approach to the situation with which we are confronted. Prior to the stark and startling realization that our shores are not immune to devastating attack which was so violently demonstrated by the outrage of Oahu, we blithely spoke of what was euphemistically termed the "emergency," and gave little more than lip service to the defense effort. Today and henceforth until an overwhelming victory is won, our every effort must be directed to furthering our war aims and attaining the goal of complete extirpation of the international brigandage which threatens the very foundations of our established mode of living.

With these thoughts in mind and realizing how stupendous is our task, it is difficult to lend an ear to those that would impress us with the importance of powder puffs and baby rattles. Plastics have so preponderate a part to play in the war program that scant attention can be accorded those that would have us believe that "business as usual" in lipsticks and poker chips is imperative and that the continued production of a vast array of what in our present extremity must be called "jimcracks" is necessary to civilian morale. We seek a sturdier type of morale than can be instilled by electric razors and juke boxes. How better can such an enduring morale be evoked than by the assurance that every pound of every vital material that we can produce is being applied to vital uses? And what industry has a more glowing opportunity to further this aim than your own?

Essential uses of plastics are legion. Such uses are becoming more numerous from day to day and they will continue to expand at an ever increasing rate. To be classed as essential it is not necessary that a material be shot from guns. Any utilization that is vital to our war economy and without which our war effort cannot properly progress is essential. Thus it should be obvious that the scope of activity open to you who work with plastics is so considerable that given his fair share of the usual ingenuity and skill with which all American enterprise is endowed, no fabricator in your industry should be unable to participate in the drive to victory.

This cannot be done without effort nor perhaps without sacrifice. Cherished notions with regard to the paths you would prefer to have your business follow may have to be relegated to the background. Painstaking search for the elusive essential usage; intensive engineering development to meet or formulate the specifications, creative retooling to adapt your facilities to the new purpose—these and many more in a seemingly unending succession will be demanded of you before the necessary reorientation in your works has been effected and the new program initiated.

Above all, we must be realistic. Marginal and submarginal uses of all materials will, of course, be severely curtailed if not entirely eliminated. Captious attempts by plastics users to foist fantastic extensions of well understood definitions on governmental leaders, of necessity will not alter the inexorable trend that has been accelerated by the outbreak of hostilities. Sixteen cups of coffee cannot be poured at one filling from a four-cup percolator. The supply of raw materials needed by the plastics industry is likewise limited, and the demands upon this limited supply for other war uses may be expected to increase constantly. Consequently, we will perforce have to eliminate uses which may have had ample justification in peace times but which are entirely out of order in a war economy.

By redirecting the efforts that too many are now wasting in purposeless fulminations against the regulations that control the distribution of plastics, these fabricators could make available a vast reservoir of energy for this formidable task of reorientation. Today is none too soon to plan for your participation in the war effort if an objective and dispassionate analysis of your products indicates that they are not essential in the present crisis. We are fast approaching the situation depicted by Lord Beaverbrook, Minister of Supply for England, who, when asked during his recent visit to the States, why in his various discourses he had never referred to civilian requirements, stated, "In Britain, we have no civilian requirements."

Arthur E. Peterson

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when this lignin paper is coated on one side with a small amount of phenolic resin, the laminated product shows better heat-resistance and some improvement in other physical properties.

Several new types of thermosetting material requiring a small percentage of the present critical chemicals are still in the experimental stage. If they can be perfected and facilities provided for their production early in the year, they may be available to the trade in small quantities before 1942 is over.

Thermoplastic materials

It now appears that there will be slightly larger quantities of thermoplastic materials available in 1942, although increased military requirements may absorb these additional amounts. In the acetate field, certain types of plasticizers are extremely critical with no definite relief in sight. Although some substitute plasticizers are being developed, it is doubtful whether these will add much to the 1942 total. Cotton linters[3] are controlled, and while no drastic shortage is anticipated, it is possible that their further use may be restricted. Because of the time required to construct them, any new facilities for increased production of basic raw materials for acetates, if approved now, would scarcely be felt until the end of 1942.

Styrene is necessary for the production of synthetic rubber, and new production facilities are being brought in to take care of this demand. On the other hand, an important quantity of styrene will be utilized for experimental purposes during 1942 in the synthetic rubber pilot plants and by the services, and this will undoubtedly reduce the amount of polystyrene available to the molding trade, although more styrene will actually be produced in 1942 than in 1941.

Methacrylates in fabricated sheet and cast forms are essential to aircraft building. With the tremendous increase in airplane production schedules, it does not appear that there will be any greater supply of these materials for molding purposes in 1942 than there was in 1941. It may be possible, however, to utilize for decorative or display purposes some of the sheets rejected by aircraft companies because of sub-standard optical properties.

The vinyl resins have been almost entirely utilized for defense purposes to date, and any additional facilities for their produc-

[3] MODERN PLASTICS *19*, No. 4, Dec. 1941, p. 84.

tion apparently will be taken up by the increased war demands.

It is almost certain that, generally speaking, there will be no more plastics materials available for molding in 1942 than there were in 1941. Since more materials will be required for war and less for civilian use, plants with a sufficient amount of war work to keep them going should have no particular difficulty. Others will not be sure of materials and may be forced to shut down completely for certain intervals if dislocations in raw materials and spasmodic shortages occur. The new ladder system for supplying and distributing materials will undoubtedly permit more advance planning than has been possible for the past several months. It is sincerely hoped, however, that permission to provide additional production facilities will be granted, so that the natural growth of the plastics industry, which has been proceeding rapidly these last few years, will not be too greatly retarded.

Molders, laminators, fabricators and extruders

The molders' answers to MODERN PLASTICS' questionnaire indicate that they appreciate the critical conditions prevailing, although to the question on how events so far had affected their business generally for 1941, 6 percent replied that they had not been affected to date. Of these, 2 percent did not have any war contracts, which indicates that their products were sufficiently high in classification to insure prompt shipment of materials. On the other hand, 94 percent stated definitely that their business had been affected. Of this percentage, a small number indicated that their business had increased; but several mentioned the fact that, although this had been true up to December, they were very skeptical of the future because they could no longer be sure of material deliveries. Of this 94 percent, 82 percent had war work and 54 percent were trying to secure some direct or sub-contract business.

In answer to the question, "What is the situation today?" 36 percent said the outlook was bad; 28 percent, fair; 16 percent, good; 16 percent, general conditions were tightening up; and 4 percent complained of labor shortage. Supplementary information in reply to this question shows that the plastics industry is definitely in a seller's market. Much additional commercial business could be booked if dies were available, and if materials were guaranteed for reasonable delivery dates.

This brings us to the third question, "Are you getting sufficient materials for civilian work?" Eighty-two percent reported "No." Of the 18 percent answering "Yes," every one had war work with priorities on materials, and several were endeavoring to secure additional war sub-contracts further to improve their position.

Defense work

Answers to question four, "Do you have any defense work either direct or sub-contract?" were rather surprising: 82 percent replied "Yes," with only 18 percent answering "No." To question five, "Is more defense work necessary for 1942 to maintain your business?" 84 percent replied "Yes," 14 percent "No," and 2 percent said it wasn't necessary if materials were available otherwise. These answers would suggest that increased production of plastics parts for the war program is thought to be essential for the maintenance of the industry.

To the next question, "If so, how do you expect to secure it?" 54 percent answered that they were trying in every possible way they knew, both direct and indirect; 22 percent stated emphatically that they did not know how to go about getting war work, and 2 percent replied that they did not need it. (On page 34 of its December issue, MODERN PLASTICS suggested methods of procedure for securing war work in plastics in an article entitled "Advice to the Molder." Herein it was stated that the prime contractors offer the best opportunities.)

The answer to the seventh question, "How many parts are you molding that substitute for metals and which metals do they replace?" show that 38 percent were producing 287 plastics parts

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Lessing J. Rosenwald is Chief of the Bureau of Industrial Conservation, OPM, and in this capacity is concerned with production for the supreme war effort.—ED.

To the Editor, Modern Plastics:

The amount of plastics going into war plants has been growing steadily and to all appearances will continue to do so. Thus far the largest portion has been of sub-contract nature and there is no reason to believe that this picture will change materially.

The increased use of plastics in defense is attributable to several causes:

1. Increased consumption of essential industrial parts that have been made of plastics for years. The electrical field is typical, wherein plastics are used extensively in electrical equipment, control devices, housings, wire coatings and similar items.

2. Replacement of critical materials, because replaced materials were scarcer or plastics were more suitable. For example, lightness coupled with strength and ease of fabrication have largely influenced their use in aviation. Some applications are: transparent enclosures for gun turrets, pulleys, flooring, control cable guides and plywood parts bonded with plastics. Lightness is also a factor in plastic parts for ships.

3. Better evaluation and appreciation of plastics. This will probably lead to wider use in non-recoverable ammunition such as fuse parts.

4. Improvements in materials and method of fabrication. Stronger materials for structural applications and new fabricating processes permitting a wider latitude in the use of materials are typical examples.

Unfortunately, as a direct result of the war there has developed a shortage of plastics.

Some relief may be afforded from time to time by changes in the supply of available raw materials. This must necessarily be temporary and uncertain, hence not subject to definite planning.

Permanent relief can only be afforded by the expansion of manufacturing facilities for raw materials. Efforts are being directed to this end. In the meantime, it is our job to guard against the waste of plastics due to unnecessary, inefficient or improper uses; to promote use, wherever possible, of the more plentiful materials in an effort to relieve pressure on the scarcer ones; to promote the development of new plastics; to stimulate the use of non-critical materials, such as lignin, soya bean, bagasse, etc., as extenders for some of the present plastics.

Plastics should arise after the war in a much stronger position. The thermosetting types should greatly expand their fast growing fields. The thermoplastic types will greatly benefit in that they will find more industrial application than heretofore. Faster and cheaper methods of mold construction, larger and more diversified fabricating equipment, new and improved materials, and innovations in fabricating processes will result in a wider application of plastics.

Lessing J. Rosenwald

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replacing aluminum, brass, copper, stainless and die-cast metals. Six percent replied that all the parts they make replace metals; 16 percent said that none of theirs do; and 20 percent, "Some," "Several" and "Many." This indicates conclusively that a large proportion of the increase in plastics volume and demand has been due to the necessity for metal replacements.

Improving conditions

The last question, "What suggestions do you have to improve conditions?" brought a variety of replies. These included suggestions for spreading the war work, cooperation of Government in developing more plastic parts, longer hours, harder work, recognition of small business, establishment of a materials distribution policy which will permit future planning, pool system of materials allocations and control of materials by the industry. Eighty percent were unanimous in suggesting that facilities be provided for additional materials.

To spread the war work it was suggested that, since the industry has more than enough molding equipment to utilize the materials available, those molders having large amounts of war work should sublet it rather than add to their own plant facilities. Furthermore, it was thought that the Government agencies should realize the reliability of small firms, appreciate their desire to do their part in the war and approve them as sources of supply for plastic parts required.

That Government agencies are slow to revise specifications and approve plastic parts for procurement is a recognized condition that will undoubtedly prevail for some time. It has not so far been absolutely necessary to find substitutes for metal parts, and the time consumed in tooling up for the production of plastic substitutes would naturally retard the war program. As Army engineers become more familiar with present-day plastics, and the types of work they can perform satisfactorily, this situation will improve. It must be borne in mind, however, that specifications for matériel are much more drastic than those for commercial items because war equipment must function satisfactorily under actual combat conditions.

The Government agencies know, however, that the cooperation of small business is essential to the nation's all-out war effort, and a competent personnel is now planning to enlist these potential producers. Meanwhile, small organizations must work out their own salvation, realizing that the little fellows must work with larger firms holding prime contracts if they want to do their share. This involves finding out what the prime contractors are doing, analyzing the various parts and operations from a cost standpoint and persuading the prime contractors that certain parts of the work can be done faster and more economically in their smaller plants.

Allocations

The last six months have been strenuous for material supplier and molder alike. Since July 1941, the material supplier has been unable to forecast accurately just how much material he can produce for the molder, who consequently has been unable to promise delivery to his customers. The formaldehyde order was drastic in that it eliminated numerous civilian items from production schedules, but it at least gave the industry a working idea of the sort of items for which materials would be allocated. When similar regulations are issued for thermoplastic materials, it should be possible to plan production for at least thirty days in advance.

This brings up the question of the best plan to follow for the allocation or distribution of thermoplastic materials. While the OPM Priorities seem to prefer the ladder plan of control which, like the formaldehyde order, makes it impossible to get materials for items at the end of the list, the industry generally prefers the so-called pool system, or a combination of the pool system and use classification plan. The pooling system contemplates the setting aside of sufficient materials to take care of war work and possibly essential civilian requirements, and then prorating the balance on a straight percentage basis over the orders on file. For example, if 20 percent of the available materials were required for war work, this proportion would be earmarked and set aside. The remaining 80 percent would be distributed for commercial use, each molder receiving 80 percent of his orders. The difficulty here lies in the fact that there would be no control over a possible expanded production of items toward the top of the list at the expense of those articles in the lower brackets. It is therefore proposed that, instead of basing the allotted percentage on the molder's orders on hand for any given month, the percentage be figured on his average monthly usage for the past 12 months as indicated by his records. This would definitely preclude any possibility of undue increases in the production of the Class I (or preferred) items, thereby creating a further shortage of materials for Classes II and III.

If a combination of the pool and the ladder systems should be adopted, percentages of orders to be allotted to molders might be

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Aircraft in general present a very large potential field for the adaptation of plastics. George W. DeBell, industrial and structural engineer, is Project Engineer, Plastics & Plywoods, of the Glenn L. Martin Company.—ED.

To the Editor, Modern Plastics:

With the advent of the present war program the aircraft industry realized that the procurement of adequate supplies of aluminum alloy would steadily become more difficult; and that, if production delays were to be avoided, the more extensive use of other materials would have to be developed. The resulting investigation indicated that plastics, including plastic-bonded plywood, had many desirable characteristics, and during 1940 and 1941 different aircraft companies carried out development programs of varying scope aimed at the utilization of this class of material. These development programs have brought forth many outstanding aircraft applications and have demonstrated that plastics are, in many cases, superior to the materials which they have replaced.

The promising results obtained during this development stage presage a tremendous increase in the amount of plastics which will be used in aircraft production during 1942. The demands for increased visibility will undoubtedly be reflected in increased procurements of transparent plastics. The use of plastics for structural parts will call for relatively large quantities of the high impact thermosetting materials, both of the molded and laminated type. The thermoplastic materials are limited to applications in minor unstressed parts, as the temperature range through which modern military airplanes must operate is such as to preclude their use in structural applications. An increase in the use of resin-bonded plywood for the larger airframe assemblies of training and combat airplanes can well be expected, particularly in the combat types.

The anticipated increase in the use of plastics in aircraft construction is, of course, dependent on the ability of the plastics industry to provide the needed raw materials, dies, and finished parts.

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The automobile industry was one of the first to recognize the potentialities of plastics for insulation, functional and decorative purposes. The following letter is from Mr. W. J. McCortney, in charge of plastics work in the Chrysler Engineering Laboratories.—ED.

To the Editor, Modern Plastics:

During the past year a great part of the country's productive energy was turned into the defense effort. Domestic manufacturing has suffered enormously from the consequent diversion of huge quantities of strategic materials, but this situation has stimulated research and development in the field of new and better materials.

Plastics and synthetic materials have been the subject of much concentrated thinking in recent months. The plastics field is a most promising source of new materials, and offers the challenge of a great amount of unexplored territory. It is only natural that product engineers should turn to it in their search for a way around the impasse.

Nowhere is the condition of material shortage more acute than in the automotive industry. In many ways plastics have provided a very admirable solution to the problem. Many developments which were under way were hastened to completion to meet the crisis. In other instances, past experience and accumulated information made it immediately possible to proffer a satisfactory material. It is estimated that already the volume of plastics used on Chrysler Corp. new cars is up 40 percent over last year's models. A program investigation now begun promises to yield even greater results.

Plastics now in use on Chrysler Corp. automobiles are found everywhere from the engine, transmission, and brake system to the steering wheel, instrument panel and body trim. High strength phenol-formaldehyde has very satisfactorily replaced aluminum in the front end oil seal plate. Because of its economy and decorative value, cellulose acetate butyrate was selected to replace chrome plated zinc in the door handles. Careful development and investigation have made possible the use of methyl methacrylate in radiator ornaments and instrument panel medallions. The latter are economically produced, have good weather-resistance and possess very desirable edge-lighting characteristics. Outside medallions, plastic thrust washers, composite brake pistons and laminated plastic glove box doors mav also be listed among the developments of this past yeai

The ever increasing use of plastics is indicative of the profound influence of this field on automotive design. For the first time automobile style artists may let out the reins on their imaginations and freely express their visions of the car of tomorrow. The use of plastics makes possible new flexibility in color and decorative pattern. The lustrous or translucent qualities of some plastics suggest design effects of a very interesting nature. The possibility of combining strength characteristics with beauty in the same plastic allows a purely functional design to be made more appealing to the eye. Thus, some dreams of the style artists, heretofore made impractical by the limitations of materials, are made capable of realization by the use of plastic designs.

Less dramatic, but of greater significance, is the impact of plastic development on the design of automotive operating parts. A design program on a particular part or unit can be carried only so far before it becomes evident that a new and better material must be found to secure further improvement. This may mean that a better bearing metal is needed, or perhaps a better brake lining, or rear axle lubricant. There are many such instances to be found in today's cars, where further development is awaiting the discovery of a new material. Automotive designers are eagerly eyeing the results of plastic research in expectation of finding the right material for some application. Up to now their success in doing this has been reassuring, and it may be expected that the development of new synthetics will have a tremendous effect in removing impediments to automotive research.

W. J. McCortney

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governed by the class into which their products fall. As an example, Class I items might be alloted 90 percent of orders, Class II, 80 percent and Class III, 70 percent. Orders again would be figured over a 12-month period. Such a procedure would have the advantages both of the pool and of the ladder systems: it would allow *some* production of every type of item; would guard against undue expansion in the production of products carrying a sufficiently high rating to guarantee delivery of materials; and would prevent the elimination of the Class III man from the industrial picture.

Molds and dies

War requires all kinds of metals and metal alloys in tremendous quantities. It is therefore not surprising that it is becoming more difficult to obtain proper steel alloys for plastic molds and dies. Tool shops which have a small supply of these materials on hand, and are able to replace withdrawals from these stocks with steel secured on priorities, are not held up. Those that must purchase their steel may experience long delays unless warehouses or jobbers have the desired types in stock. Apparently not too much difficulty has been experienced by tool and machine shops in getting supplies or maintenance parts to date. As more machine tools are placed in service, however, maintenance parts will undoubtedly be harder to procure.

One of the biggest handicaps of the tool shops today is the lack of skilled labor. It requires years of experience for a man to qualify as a skilled machinist or die maker, and consequently there is no large labor pool to draw on when the industry wants to expand quickly. Therefore, in order to increase production, the skilled mold maker must put in overtime. It has been estimated that mold costs have increased 50 to 100 percent over those of the previous year, and deliveries have also been slowed down because steel is not always immediately available.

With material shortages prevailing and no increased supplies in the offing, industry generally is reluctant to put capital into molds and dies to be used in commercial manufacture. War work has taken up some of this tool-shop slack and will undoubtedly absorb more. Some tool shops have protected themselves by war contracts covering molds, dies, maintenance, repair and even production parts, all on a priority basis which insures delivery of materials, tools and anything else required except labor. As more of tool-shop work is diverted to the war program, commercial molders will experience greater delays in securing deliveries on molds and dies.

Machinery

Inasmuch as a large percentage of the presses and machinery required in the plastics industry is built (*Please turn to page 92*)

Resin-bonded friction materials

by D. S. BRUCE and R. T. HALSTEAD*

Phenolic bonding agents increase wear-resistance and life of brake linings, and contribute to frictional characteristics

An automobile driver operates his car at a high rate of speed with perfect confidence that, if necessary, a quick, safe stop can be made by a simple push on the brake pedal. In the oil field, a driller engaged in sinking a well many thousands of feet deep relies on his brake to hold in suspension his drill and its great length of connecting pipe. A giant mechanical shovel or crane performs its miracle of labor, and throughout the entire operation the nearly human motion of the machine is in response to the controlled action of the giant's brake linings, cone clutches and clutch facings. The modern elevator, the centrifuge, even the aeroplane must have a suitable friction material to arrest its motion. Though the demands on the friction material placed in such service are often extreme, the use of selected synthetic resins and plastics in the manufacture of friction materials has gone far toward successfully meeting these exacting service conditions.

The problem of developing friction products to meet modern service conditions involved a search for materials which would be inherently more resistant to the deteriorating effect of the heat and wear resulting from severe brake or clutch applications. Surface temperatures of brake lining in active service range hundreds of degrees above normal atmospheric temperatures. The destructive action of such temperatures on the plastic or organic components of brake lining is, of course, pronounced. With a definite trend in recent years toward automobiles with greater acceleration, together with a requirement for greater deceleration, the search for more heat-stable ingredients for use in friction materials became a necessity. It is no exaggeration to state that the answer to this quest has to date been supplied more effectively by thermosetting resins than by any other class of material.

Thermosetting resins have, of course, been available to the brake-lining manufacturer for many years. Their use at first was limited, as might be expected, to relatively simple impregnation processes in which asbestos fabric or mill-board was immersed in a bath containing a thermosetting resin. Experience gained in these applications of resins soon led to more far-reaching innovations in which these thermosetting materials were incorporated wherever an increased measure of heat resistance was desired. For example, hard rubber, a thermoplastic material even when thoroughly compounded and cured in accordance with the most advanced practices, was accorded a notable increase in resistance to thermal deformation and disintegration by admixing with the proper type of thermosetting resin.

In the meantime the resin manufacturer, becoming increasingly aware of this new field of application, was taking

* Johns-Manville.

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1—*General arrangement of molding equipment used in the manufacture of a resin-bonded brake block (shown in foreground).* 2—*Multiple-cavity curing molds for forming and curing molded linings under heat and extreme pressure in a hydraulic press.* 3—*Large industrial cone clutch linings are machined to customers' specifications in a boring mill.* 4—*Both brake blocks and molded linings are finished by grinding on this huge end grinder*

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stock, re-evaluating many of his products and developing new ones designed to meet certain specific requirements in this connection. Both resin and brake-lining manufacturers acted cooperatively to establish the suitability of certain types of phenolic resin products. Primarily as a result of the development work done at this time, there followed a period of volume usage of resins which has continued through to the present, and which shows every indication of continuing to grow as applications to brake blocks and clutch facings come in for more and more consideration.

The frictional and wear-resistance requirements of brake linings are primary in any consideration of desirable properties which materials going into them should possess. Both of these factors are profoundly affected by heat. It has yet to be demonstrated that existing plastics can be so processed or compounded as to yield a product with a coefficient of friction independent of temperature. The use of synthetic resinous products has within limits, however, advanced the art of friction materials manufacture nearer to this goal than has the use of any other class of ingredients. The limitations implied in the preceding statement depend primarily upon the high temperature range involved. Under temperature conditions within the melting or the disintegration range of the plastic component, extreme changes in frictional values are a logical expectation. Flash temperatures, probably involving little more than the surface layer of the friction material, are oftentimes indicated to be much higher than the 1000 deg. F. operating temperature actually recorded by pyrometer measurements. Under such service conditions it becomes evident that the organic component, even when reinforced by suitable resin additions, is subjected to temperature conditions that thoroughly tax its heat stability. These operating temperatures, occurring under conditions limiting the amount of oxygen in contact with the hot surfaces, may be likened in their effect to a destructive distillation proeess. Even the most heat-stable of the thermosetting resins commercially available today will, under the effect of destructive distillation, break down to yield liquid fractions of an oily nature. The presence of such an oily film is conducive to erratic brake performance. Even under more moderate conditions of service which do not produce perceptible pyrolytic changes, the plastic component undergoes sufficient physical alteration in its frictional characteristics to cause its effectiveness in a hot brake lining to be quite different from its effectiveness in a lining that is cold.

Likewise the life of a friction material, measured in terms of rate of wear, is influenced by the temperature at which the braking operation is carried out. The increased wear or decreased life resulting from operations conducted at elevated temperatures is shown in Table I for a conventional friction material (A) containing no synthetic plastic, and for a friction material (B) carrying a full complement of thermally set resins (see page 94).

Other physical qualities that are improved through the incorporation of thermosetting resins in friction materials include the following:

Resistance to deformation: A brake block or brake lining with a low wear factor would normally be expected to give long service. If, however, under the pressure of brake application the friction material deforms (*Please turn to page 94*)

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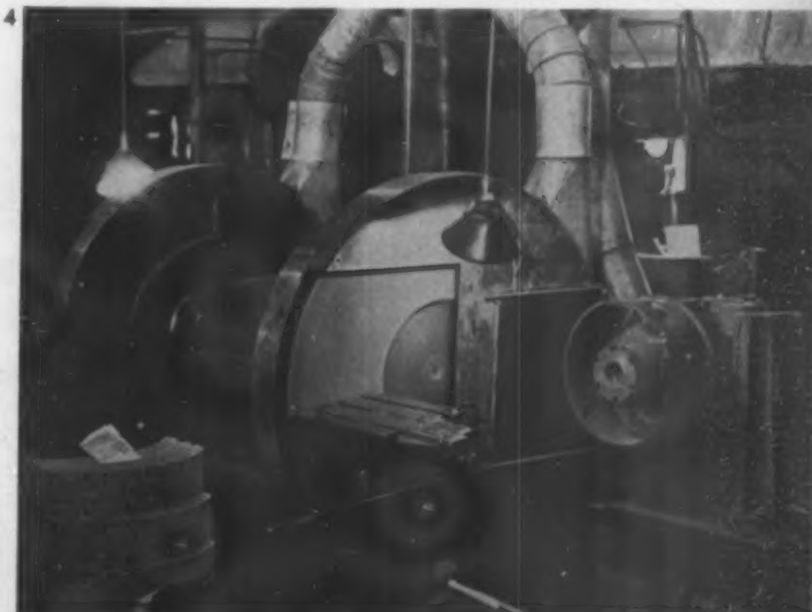

Victory Trainer

High-speed training planes of plastic-bonded plywood save precious aluminum for America's bombers and fighters

THE critical rôle of airpower, now demonstrated in the Pacific, points up the necessity for planes, planes and more planes. Speed-up of production is the keynote and new methods have been devised to increase the tempo of plane building. With aluminum, magnesium and other light metals vitally needed for high-performance bombers and fighters, the builders of the equally important trainers must make an effort to reduce their own consumption of these scarce materials. To this end, a new type of plastic-bonded plywood ship has been particularly designed for flight schools which train civilians to handle a military type of plane.

Called the Victory Trainer, the plane was developed by Morrow Aircraft Corp. and features a retractable landing gear said to result in increased speed. The plane is built throughout of wood fastened together with a resin glue. Much of the wood is formed in special presses to exact shape and contour for direct installation over wing and fuselage framework. Large molded sheets form the rivetless skin of the wing leading edge and fuselage. The latter connects two shells—one for each side.

Manufacturing methods are similar to those employed in the production of other recently developed plastic-plywood planes, such as those made by Vidal, Langley, Timm, etc.

Laminated wood bulkhead rings, plastic-bonded with the new type resin glues, are set in jigs, to which spruce stringers are attached longitudinally. Over the fuselage stringers, which run from the engine firewall to the tail, the fuselage skin, consisting of inner and outer molded sections of plywood, is attached with resin glue. The entire skin for the fuselage consists of but two halves, which carry part of the stresses. No rivets or bolts are required. When given its finishing paint, the fuselage surface is smooth as glass.

The full-cantilever wing consists of a continuous section to which the fuselage and outer wing tips are bolted. A resin-bonded, box-type wood spar runs from one end of the wing to the other at the rear of the wing, and to this spar are attached the flaps and the ailerons. The front spar extends only from the landing gear on one side of the plane to the landing gear on the opposite side. Ribs are constructed of a solid plywood web with laminated caps and stiffeners, for good rigidity.

Covering of the wing and the tail surfaces is of plastic-bonded plywood, attached to the stiffeners and ribs with casein glue. Like the fuselage, the wings and tail surfaces are free from rivets or other protruding fastening devices and when finished present a glass-like surface. Tail surfaces are constructed and finished in the same manner as the wing.

Landing gear is of the hydraulic retractable type, folding in toward the fuselage. A hand pump, located in each cockpit, raises or lowers the landing gear in six seconds, through hydraulic pressure created by the hand pump's operating of retracting cylinders on each leg of the landing gear.

Brakes on the wheels are hydraulically operated by toe-type pedals integral with the rudder pedals. A special development which is standard equipment of the trainers is a hydraulic brake lock which performs the same function as a parking brake in a car.

Cockpit enclosures formed from acrylic sheets over the laminated bulkhead rings are a permanent part of the airplane. Doors are provided at each cockpit for easy access by means of quick releasing latches.

Engine mount is constructed of welded tubular steel, and rubber vibration dampeners support the six-cylinder, horizontally opposed, 175-h.p. Lycoming engine.

The manufacturer developed his special process for forming and molding the plastic-bonded plywood after months of study and research. The molded plastic-plywood is virtually fire-resistant, impervious to water or oil, and at the same time is highly resistant to shock and impact. A feature of particular importance is the ease of maintenance and repair. Special machinery is not required.

From an aerodynamic standpoint, the high-speed trainer is a step forward in planes of this type. Weight and surface friction are reduced to a minimum by avoiding the use of rivets with their attendant drag. This has added over 25 miles per hour to the performance of the plane over any other ship of the same horsepower. Thus, the high speed and performance desired in secondary trainers is achieved without excessive power, which reduces initial investment and operations costs.

The Victory Trainer has a wing span of 30 ft. 4 in., an over-all length of 25 ft. 4 in., a height of 7 ft. 9 in. and a weight empty of 1656 lbs. Payload consists of two pilots, parachutes, gasoline and oil for a maximum of 1000 miles range, and the necessary flight and radio instruments. Top speed is in excess of 165 miles per hour, with a cruising speed at $^2/_3$ power output of 145 m.p.h. Landing speed with flaps up is 70 m.p.h. and 55 m.p.h. with flaps down.

Standard equipment includes hydraulically-operated retractable landing gear, using specially designed hand pump, oleo shock struts and hydraulic brakes; hydraulically-operated split flaps; complete sets of Kollsman flight instruments on shock-mounted instrument panels in both cockpits; adjustable rudder pedals; special hydraulic brake locks; Ranger receiver and transmitter in rear cockpit only; and hand fire-extinguisher.

Development of the trainer and the use of plastic-bonded plywood throughout the entire ship may help speed aircraft production by permitting the use of construction materials available from Pacific Coast timberlands along with synthetic resins. Aluminum and steel have been confined to such functional applications as the landing gear and engine mount, etc. Rapid production of the plastic-bonded plywood planes is not hampered by labor shortages, as workmen skilled in furniture and allied wood products industries can rapidly be trained to such plane-manufacturing procedure.

Each plastic-bonded plywood plane used for training is making its individual contribution to a fighting plane for the Army or Navy air arm so that, as Secretary of War Stimson has said, "... the enormous power of a hemispheric defense which, radiating out from the manufacturers and training grounds of the United States and taking advantage of our now existing ocean and continental bases, may strike at and ward off agressive hostile sea power long before it is able to reach our shores."

Credits—Designed and manufactured by Howard and Frank Morrow. Vance Breese, airplane test pilot and consulting engineer

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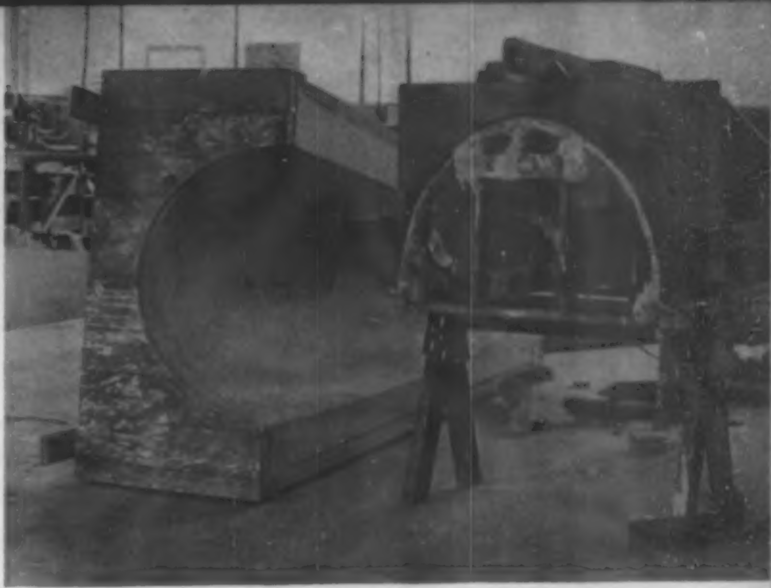

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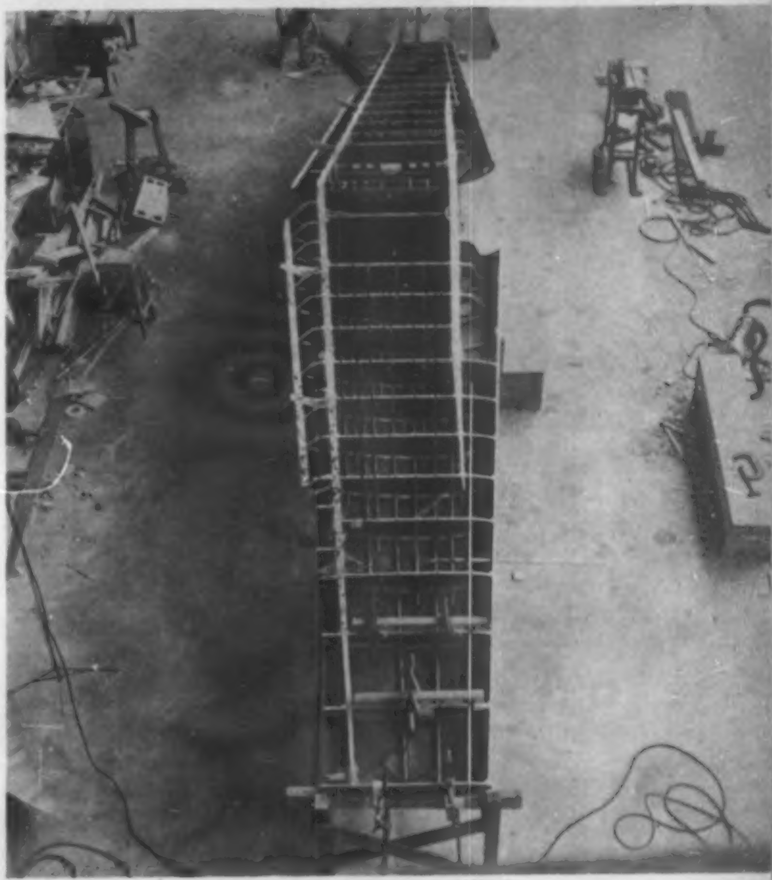

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1—Speedy Morrow plastic plywood plane is designed for civilian pilot training. 2—Large molds especially developed for use in forming the one-piece plastic-bonded plywood turtle deck for the two-shell fuselage. 3—A view of the under side of the half-completed, full cantilever wing showing the self-sealing integral gasoline tanks on either side of the fuselage attachment point. 4—Assembling the resin-bonded plywood outer skin onto the fuselage framework. Each half is molded to shape and securely plastic-bonded to the fuselage, which is heavily ribbed both lengthwise and circumferentially for greater strength

X-ray watch models

An inside view of the works! Hand-made demonstration watch models—one an actual size, 23 jewel pocket model, the other a five-diameter enlargement of a standard strap watch movement—are constructed entirely of methyl methacrylate except for wheels, jewels, springs and screws. Before these models were made, not even the most skilled watch technicians had ever seen a watch in operation, we are told. That these plastic watches really work is amazing since in an ordinary watch, plates and bridges are made of nickel steel in order that they will remain absolutely rigid and will not be seriously affected by temperature changes. The enlarged model (right) which requires a tremendous amount of power to operate at all, is not an accurate timekeeper since the balance wheel swings just once each second and the mainspring is a cut-down phonograph mainspring.

The small watch is reported to have operated with an accuracy comparable to a regular watch of the same size and type. The material in the form of disks was cut from 2-in. diameter methyl methacrylate bar into 6 disks, two for the pillar plate and bridges, one for the main part of the case, two for the front and back bezels and one for the dial. Thickness of the pieces varies from $^1/_{16}$ in. to $^1/_4$ in. To prevent shrinkage of the finished product, disks, after being machined roughly to size on a watchmaker's lathe, were *sun-dried* to prevent shrinkage. Any change of shape—caused by shrinkage—would have shown up immediately, since in a number of places distances must be held to within .0002 in.

Case is made in three sections and put together by snap action. Glass crystals, front and back, snap fit into the plastic bezels. All screws are threaded directly into the plastic, except jewel screws which are threaded into flanged steel nuts pressed friction tight into the material. The main parts of the movement—pillar plate and bridges (which are the bearing plates)—were machined as two halves. Bow and winding crown are of plastic, too.

Credits—Material: Lucite. Fabricated and designed by Technical and Research Departments, Hamilton Watch Company

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Waterwheel guide bearings

Substitution of laminated phenolic for lignum vitae, a natural tropical wood, has increased the life of waterwheel guide bearings from $3^1/_2$ to 14 years, over 400 percent.

Before the change was made, the lignum vitae in the bearings was replaced on the average of once every three or four years. Originally installed with a clearance of .015 in., the bearings wore .050 in. in this time. Changing bearings means a labor cost of about $100 and a loss of 20 hours in power generation. Moreover, unbalanced shafts caused by rocks in the runner resulted in additional loss in generating time. Due to the low water absorption of the material, it was possible to install the bearing with a clearance of .009 in. This is $^3/_5$ the clearance when lignum vitae was used. During the past four years the bearing wear averaged .0025 in. as compared to .015 in. for lignum vitae. Since .050 in. is considered the maximum allowable clearance, it is expected that the material will last 14 years.

It is estimated that there is an annual savings of $50 in cost of materials alone when laminated phenolic staves are installed in a waterwheel guide bearing sleeve. The laminated phenolic strips—which workmen are removing in the illustration at the left—are used around the circumference of the shell with spaces between. The space is designed to allow circulation of water for the lubricant.

Credits—Material: Micarta. Manufactured by Westinghouse Electric and Manufacturing Company

Portable lamp parts

Interchangeable plastic shapes, injection molded of cellulose acetate in brilliant colors, bring to light new possibilities for economical design variations for portable lamps. Bases, shafts and sections called "breaks" by the trade are made in standard sizes with common dimensions so that combinations of different parts can be used to produce different lamps. While color is important from the decorative angle,the plastic parts have a permanent finish that will withstand unfavorable weather conditions in almost any climate, are lightweight and can be stored or handled without danger to the finish. This makes it feasible for dealers to keep large stocks on hand. Luster is inherent in the plastic—obviating the comparatively slow and costly processes of lacquering, polishing and plating necessary on metal parts. Application of the precision molded plastic ornaments is speedy; simple adhesives are used. The resiliency of the plastic parts enables them to withstand blows that would ruin the finish and shape of other materials. Improved balanced construction is possible as the lamp is relieved of much unnecessary weight above the base.

Included in the parts at right are fluted shafts which are reinforced with a metal tube for greater strength and to prevent any alteration of shape in use. In addition to merchandising advantages, plastics replace strategic materials, although plastics were specified before any metal restrictions.

Credits—Material: Nixonite shaft. Tenite and Lumarith base and breaks. Molded by Elmer E. Mills Corp. for Colonial Premier Company

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Re-use textile spools

Precision molded phenolic cones designed to fit readily on almost all established types of spinning and weaving equipment provide the textile industry with sturdy spool or yarn holders which can be used over and over. A distinct improvement over the short-lived wooden and pressed pulp yarn holders previously employed by the textile industry, the plastic spools have a smooth, lustrous, hard surface that insures even, firm winding of the yarn and reduces the possibility of snagging or yarn breaks while the spool is revolving rapidly. The permanent all-through color of the plastic will not soil, "mark off" or discolor even light yarns. The molded phenolic cones are immune to the effects of lubricants, oils, acids and fluid used in processing yarn, and are moisture-resistant. Although not proof against breaking, spools will not shatter if dropped, and have good impact resistance.

Extremely durable, spools are sufficiently light in weight to permit them to be shipped economically from yarn supplier to weaver and back, with little danger of damage in transit. Each spool is uniform in size to the thousandth of an inch, so that they are easily installed on all types of textile machinery. These were particularly planned to be used in connection with nylon yarn for the manufacture of hosiery. Spools were economically designed to incorporate the minimum amount of plastic material and were molded to achieve perfect balance in operation, so that yarn can be handled in smooth continuous motion and can be stored easily without danger of their falling because of the top-heavy load of thread. As shown in the cone in the lower left hand corner of the photograph opposite key ways, in the inner base of the part, are designed so the spools lock securely on the shaft of the machine.

Although cost of the spools may have exceeded that of wooden or pulp holders, the possibilities of practically unlimited use more than compensate for such differences.

Credits—Material: Resinox. Molded by Spools, Inc., for Premier Thread Company

The eyes have it

by EDWARD J. YOUNG*

Personality-styled frames from cellulose nitrate sheet stock revive the market for plastic spectacles

IT'S a far cry from dull steel spectacle frames of thirty years ago to brightly colored plastic eyeglass frames shaped to suit the contour of the face, bent and twisted in a variety of appealing and whimsical designs, but the modern woman has accepted them with the same eagerness as she has any other sound fashion innovation.

Credit must be given to the skill of the fabricators, and to the raw material suppliers for the rapid improvements made in their product. The modern plastic frame did not progress to its present state in one step, but passed through a gradual transition from the old, heavy-looking simulated tortoise-shell plastic spectacle. While the mottled plastic frame was making a new sales record, rimless spectacle frames came into popularity—a threat to the plastic frame. Designers in plastics attacked the problem of producing appealing plastic frames with new zeal. One of the factors in favor of plastics was the color that could be achieved with cellulose nitrate material. The designer had a range of beautiful tints and colors from which to choose—flesh tones, transparent, aqua, blue, red, green, yellow. These many shades created the selling idea of selecting eyewear to harmonize with make-up and complexion, hats and dresses. Even two-tone effects were created. This was done by carving, frazing and sandpapering part of the upper layer to expose the color beneath.

The theory propounded was that frames can be fitted to facial contours, individual frames made for various types of faces. It seemed logical that a round frame, which might look well on a girl with smooth, oval features, would not look the same on a girl with a long slender profile. This theory became an actuality and, with the aid of leading beauty experts, smart milliners and the fashion press, this idea was put across to style-conscious women. Women's Page writers, newspaper columnists and magazine writers have commented favorably on eyewear for every type of face. They have pointed out that it is wise to select your eyeglass frames to suit features, personality, coiffure, clothing and coloring. One famous beauty authority put her stamp of approval on this style by designing a coiffure (*Please turn to page 98*)

* Advertising and sales promotion manager, Optical Products Corp.

Bespectacled fair ladies trust to lightweight colorful plastic frames to highlight their charms. Lenses and rims fit facial contours, coloring, coiffure and costume. Economy of fabrication, durability and accuracy of plastic spectacles, which use a minimum of metal, result in increase sales of conservative styles as well

1—There are various types of thread-producing screws available today. Pictured here is a representative group. The screws may be divided by threads into United States Standard and spaced threads

Thread-producing screws for plastics

by W. M. HANNEMAN*

MODERN design and fabrication requires ever increasing quantities of plastic parts. Although many molded parts are complete within themselves, many others form only a part of a unit or assembly. Often two or more plastic parts constitute an assembly. Sometimes, as in the case of industrial control units, the plastic part becomes the base onto which other parts are assembled.

The joining of several parts, at least one of which is a plastic, has created new problems of fastening. Manufacturers of fastening units have done a creditable job in supplying suitable methods and there is now available a choice of different means of holding pieces together. As is the case with metals, however, the use of screw fastenings is still the most universal.

Where the mating thread for a screw must be in a plastic part, the most secure method is to mold a threaded metallic insert in the plastic. This is also the most expensive method because of the cost of inserts as well as additional molding costs.

If some of the holding strength of the screw can be sacrificed, the inserts may be eliminated and a plain hole molded in the piece instead. This hole is then tapped for use in conjunction with ordinary machine screws. The tapping operation may also be eliminated if thread-producing screws are used in the plain hole. This is the most simple and least expensive of the methods of assembling with screws. The resulting fit between the screw and its mating threaded hole is snug and secure from loosening through vibration as the necessary manufacturing clearance between screws and tapped holes is eliminated.

* Research Engineer, Shakeproof, Inc., and Illinois Tool Works.

Since there is a great variety of plastics, each with its individual characteristics, certain types of thread-producing screws, satisfactory in some materials, are entirely unsatisfactory in others. Thermosetting plastics, such as the phenolics and ureas, have little elasticity and, unless sufficient wall strength is built in around the hole, the material may fracture due to the expansive forces set up by the insertion of a screw. Thermoplastic materials have lower shear strength which, in some applications, makes the use of fine thread screws less satisfactory than that of coarse thread screws as practical experience has shown.

In the selection of a thread-producing screw for use in a particular plastic, the characteristics of both the screw and the plastic must be considered. Different types of screws have variations in holding strength in the same materials. Depth of screw penetration into the plastic also has an effect on the holding power.

The ideal screw for general use in plastics should embody the following characteristics:

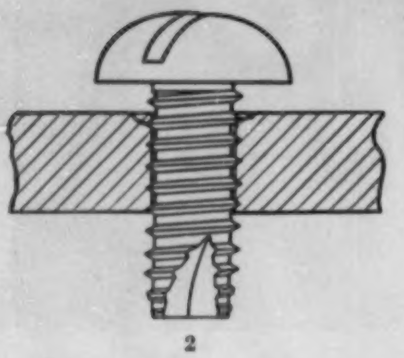
It should require a low driving torque to create its mating thread in the plastic.

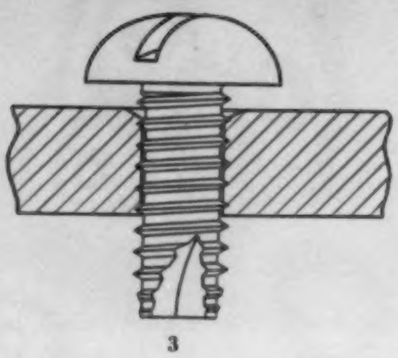
It should require a high driving torque to strip the thread out of the plastic.

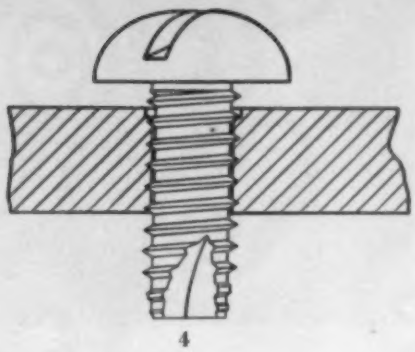
It should possess a large difference between driving and stripping torques to permit trouble-free use of power drivers in quick assembly.

It should produce very little expansive force when used in the hard brittle plastics.

Fortunately, screws for use in plastics may be made of various materials: steel for low cost, monel or stainless for rust resistance and appearance and brass or bronze for electrical needs. (*Please turn to next page*)







These diagrams show various methods of handling thread-producing screws for plastics

There are various types of thread-producing screws available. Figure 1 shows some of these types. They may be divided by threads into United States Standard and spaced threads. They may also be divided into classes according to whether or not they have definite cutting edges. Screws with cutting edges, as represented by the multi-flute, hi-hook and plastiscrews, create mating threads in the hole in the plastic by removing material to form a path for the screw thread. Where no cutting edges are on the screw, the mating thread is formed by the screw thread forcing a path in the hole by pressure alone. The sheet metal and thread-forming screws function in this manner.

The grooves in the multi-flute screw are produced during the thread rolling operation, whereas the slots in the hi-hook and plastiscrew are created by means of saws or cutters after the thread rolling is completed in the usual way of producing machine screws.

The multi-flute screw has more cutting edges than the two other types, and is quite satisfactory for many applications, especially the phenolics and ureas. When driven into relatively shallow holes, the holding power is somewhat lower because of the absence of threads in the flutes, which results in less thread area being in contact with the work. In this type of application they also strip at lower torques. In very deep holes the chips produced by the cutting edges have a tendency to pack into the flutes due to lack of chip room. When this occurs the chips become packed into a solid mass which creates expanding pressure and also interferes with the proper action of the cutting edges.

The hi-hook screw is so designed as to incorporate a thread-cutting screw with a double slot milled in after the screw is formed. One of these slots is so placed as to form a sharp thread-cutting action. The second slot, in addition to creating greater chip capacity, also makes a weakened section on the screw which in the harder materials may yield and provide a more exposed cutting edge.

Both the multi-flute and hi-hook screws are manufactured with United States Standard threads to Class 2 tolerances, and have a smaller diameter at the point than on the body of the screw to permit easy entry into the hole.

The plastiscrew also has a tapered point, but has a coarser pitch than standard thread. The design of the slot in the end of the plastiscrew is such that a sharp acute cutting edge is presented to the work piece hole for free cutting. The resulting chips are deflected toward the bottom of the slot, which is so designed as to again deflect them toward the end of the screw. The design of this slot is such that no chip confining space is created, and therefore regardless of how deeply the screw is driven into the hole, there is no possibility of chips becoming packed in the slot.

When comparing fine and coarse threaded screws it must be remembered that the fine thread has a slight mechanical advantage over the coarse thread. By this it is meant that, with the same applied torque to the head of a screw, greater tension is set up in the fine threaded than in the coarse threaded screw. In overdriving, which results in stripping the threads from the plastic, it is the tension set up in the screw which causes this failure. Therefore, in plastic applications it is desirable to have the ratio of driving torque to tension as low as possible. The coarser threads have the lower ratio. However, a high driving torque nullifies this advantage. This is of more importance in the thermoplastic than in the thermosetting materials.

When thread-producing screws are driven into cored holes in the harder plastics, there is some inclination toward chipping around the edge of the hole (see Fig. 2). This is particularly true when unslotted screws are used, since the internal pressure set up creates this condition. Chipping also occurs when slotted screws are used if the screws are not started reasonably straight into the holes, as occurs when care is not taken in driving. As the screw enters deeper into the hole it tends to straighten up, and this lifts a chip from the face of the plastic because of the pressure set up at this point.

Chipping around holes may be reduced or eliminated if the hole, instead of having a full diameter up to the surface of the plastic, is molded with a 120 deg. countersink (see Fig. 3) or is molded with a counterbore having a diameter equal to that of the screw thread for a short distance below the surface of the plastic (see Fig. 4). With counterbored holes, chipping may still occur, but on a reduced scale, and is less obvious.

To duplicate with screws in plastics the holding power of screws in metallic (*Please turn to page 84*)

Measure for measure

FROM cork to brass to plastics—the development of an improved line of lever and multiple float type oil gages for measuring liquid levels reflects the trend toward replacement of vital materials. The first transition occurred as a result of the shortage of cork arising out of the limitation of exports from Spain during its Civil War. Cork floats were replaced with brass. As the demand for metals became urgent a plastic float was designed which had the same buoyancy as the cork, the approximate dimensions of the brass part and, in addition, permanent color and corrosion-, moisture- and oil-resistance.

Simultaneously other parts, in standard sizes so they could be interchangeable on all types of gages made by the company, were redesigned in plastics. Transparent injection molded cellulose acetate tops, vinyl calibration charts, extruded cellulosic tubing; molded needles, spring supports, spring guides and float rings have been produced with considerable savings in production and assembly costs and have the added color appeal which results in increased sales.

These gages are used to measure the contents of vented indoor fuel-oil storage tanks. Their general principle of operation is simple and direct, and they are easily installed regardless of fuel level. One gage, the lever type, works by direct leverage. The transparent plastic head fits into the tank bushing and the plastic float, attached to a hinged, cadmium plated sub-assembly, is inserted in the tank. As the level of fluid in the tank decreases, the sub-assembly, which is connected with the spring type indicator and pointer inside the gage head, drops, thus registering the level on a calibration card inside the plastic head.

The multiple-float type gage operates in the same way and can be installed without dis-assembling. A string of sausage-like plastic floats, attached to a spring-supported pointer inside the head of the gage, is inserted within the tank opening and the tank bushing of the gage made tight. As changes in fuel level occur, the unsupported weight of the float is varied, thus altering the position of the indicator, which points to the liquid level on a calibrated scale.

Essentially the gages consist of the body, the top, the float assembly and the float or floats proper. The body or tank bushing of the gage has a transparent molded acetate top fitting into a one-piece malleable iron threaded end with $1^1/_2$ or 2-in. standard pipe threads. An integrally cast hexagonal supporting flange is provided on each body to serve as a wrench grip for screwing it tightly into the tank flange. Its location is usually above the highest liquid level in the tank but it is easily installed at any level.

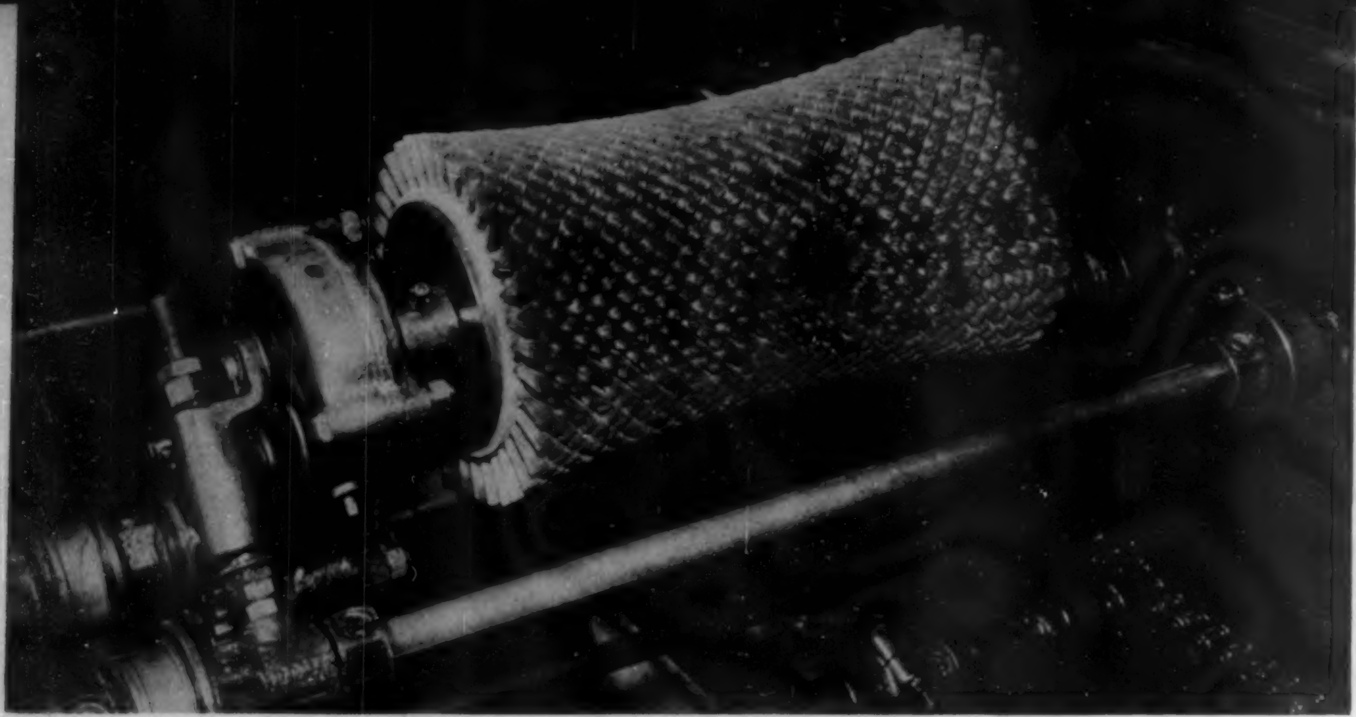
The transparent plastic head is accurately molded to close tolerances so that it is proof against oil and pressure. It permits a clear view of the calibrated scale within and may be quickly adjusted to face in any desired direction. The head is slotted at the top to provide for insertion of a dealer's business card, or advertising message. The large 3-in. gage scale, printed on vinyl sheet, will not deteriorate or discolor by the action of the fuel handled. Other plastic parts are similarly corrosion-resistant, light and accurate. The sausage-like floats are injection molded in two halves which fit snugly together. Both the lever type and multiple-float gage units are available in standard sizes.

Credits—Materials: Fibestos, Tenite, Lumarith. Molder: Tops, floats, float rings by Commonwealth Plastics Co. Needles, spring supports by Earl S. Tupper. Extruded tubing, Mack Molding Co. Vinylite calibration charts: Bastian Bros. Designed by John D'Arcey, Inc., for Detroit Lubricator Company

1—Improved efficiency and economy for lever and multiple float type oil gages is achieved with plastics for sausage-like floats, rings, transparent top, tubing calibration card, etc. 2—Former metal model which was redesigned in plastics

1

2



1

1—This sewage brush bristled with nylon is used in the fine-screen plant of a city sewage disposal plant. It was found that the bristles outlasted natural brushes formerly used. 2—Brushes for industrial and professional use

Longer-wearing bristles for industry

JUST three years ago, nylon was introduced for toothbrush bristles and today nylon filament in large diameters is used for longer-wearing bristles for more than 22 industries, ranging from textiles and electroplating to dairying and brewing. A digest of the accomplishments of the material in the American brush market reveals some interesting statistics.

Nylon in large diameters will bristle about 90 percent of all toothbrushes manufactured in this country during 1941. It will bristle more than 50 percent of all hairbrushes manufactured here in 1941; and it will be used for tennis and badminton racket strings, catheters, surgical sutures, fishing leaders and snells, shoemaker's bristles, nylon-wound musical instruments strings, household brushes and other products.

2

The pound production figure of nylon in large diameters was 95 percent greater in 1939 than in 1938, 220 percent greater in 1940 than in 1939. For the first eight months of 1941, production has increased 42 percent over the entire 1940 production.

There is a constantly increasing adaption of nylon bristles to industrial brushes. They are claimed to outwear natural and fiber bristles in many brushes, to resist the effects of most chemicals commonly met in industrial use and, furthermore, not to fray, split or become brittle. The bristles are manufactured in mechanically controlled, uniform diameters and lengths.

For example, to help clean 7,000,000 beer bottles annually, nylon-bristled brushes whirling as fast as 3000 r.p.m. are forced through narrow bottle necks to scrub the interior under a shower of water with an alkali cleaning agent. Hog bristles quickly wear out under this constant flexing and whirling; and nylon bristles wash from four to five times as many bottles as the natural bristles. Nylon bristles were found practical for gun brushes because they do not soften in strong cleaning solutions.

The new rug cleaning brushes typify some of nylon's superior properties. Fiber-bristled brushes for scrubbing heavy rugs had to be reversed after three weeks so that all bristles would wear evenly. The maximum life span of these brushes was six weeks. Nylon-bristled brushes, installed at a large laundry in Washington, D. C., on July 28, have shown no apparent wear, splitting or softening after three months. Nylon, in short, has helped relieve uncertain imports of bristling material and, potentially, make America self-sufficient in this material.

A New Year's scrap resolution

THE American people have long had the unenviable reputation of being the most wasteful in the world. Because our natural resources are so great, we have fancied them to be practically inexhaustible.

Because we are a great manufacturing nation, we have assumed that production, even in the extravagant manner, can always outdistance consumption.

American prodigality has come to an abrupt halt. Cautioned by the Government that it must now conserve supplies and reclaim waste, U. S. industry must today cast about it for ways and means of putting every ounce of material at its disposal into production and more production.

As the new year begins, the plastics industry can make a worthwhile contribution to the war effort by resolving (1) to perfect its performance so that waste may be avoided, and (2) to salvage and reuse its scrap. If it were possible to utilize from 10 to 20 percent of scrap, it is estimated that some 1,000,000 lbs. of additional molding material could be made available, most of it in the thermosetting class.

Thermosetting materials

The most elementary method of dealing with waste is to have less of it to begin with. This means that handling of material and procedure in molding it should be painstaking and accurate. Materials in the thermosetting class are usually weighed, measured or preformed to produce the best molding results. In executing these operations, care should be taken to prevent contamination which might mean later rejection of the molded parts. Measured or weighed charges and preforms should be automatically checked very frequently to insure both against excess quantity of material, which causes more flash or possibly heavier parts, and against insufficient quantity, which may mean poorly filled parts and consequently a higher proportion of scrap.

Molds should be checked to make sure that they register properly, and cavities and cores must be kept polished to eliminate unnecessary finishing operations. Any machining operations on the finished parts should be carefully controlled.

Assuming that these precautions have all been taken and that a certain amount of potential scrap has been automatically eliminated, there arises the problem of dealing with the proportion that still remains. Due to the many formulations represented, it will be well to segregate the parts and the flash both as to color and as to compounds. All scrap should be kept as clean as possible, and if metal inserts are molded into the parts, these should be removed before the parts are reclaimed. The molded parts, having been cured under heat and pressure, should then be segregated from the flash because it may be possible to regrind and use a small percentage (1–5 percent is one estimate) of them with virgin powder—providing, of course, that the applications and specifications make it permissible.

Inasmuch as the flash presumably has not been thoroughly cured or subjected to the same heat and pressure as have the molded parts, a possible 1 to 15 percent may be reground and used with virgin powder—again, if the parts and specifications will stand it. Sound judgment must be exercised with regard to percentage of scrap utilized, because the use of reground materials, either from flash or from parts, may be definitely objectionable for certain types of work.

For best results, the materials should be reground fine enough to pass through a 60- or 80-mesh screen. The equipment and set-up for doing this work are expensive; and although such work can be performed economically by firms especially equipped to do it, the handling and freight charges may make reclamation costs exorbitant for plants that must ship their scrap elsewhere to be reground. In these critical times, however, its possibilities should be carefully considered. Mold finishes should be carefully watched when scrap materials are used, because of the possible abrasive action on the molds, particularly when considerable flow is necessary.

If color is important, the parts containing reconditioned scrap may be sprayed or dipped after molding. In view of the shortage of most metals, some parts may be molded in thermosetting materials embodying an approved amount of scrap and sprayed with a thin coating of metal (if any can be secured for such purposes) to yield satisfactory metal finishes with a minimum use of that critical material.

Thermoplastic materials

With thermoplastic as with thermosetting materials, the first step toward economy is in the direction of more precise molding performance. Injection equipment should be maintained at maximum efficiency. Mold clamps and die fits must be as accurate as practicable. Molds should be periodically checked for finish, matched parting lines and land seals. When checking a new die, only reground scrap materials should be used. Extreme care should be taken not to mix incompatible materials such as acetate, butyrate, polystyrene, methyl methacrylate, ethyl cellulose or vinyl for regrinding. Any mixture of these materials will definitely ruin them for remolding purposes.

With some injection machines not equipped with power feed mechanism, it is possible to clip small sized sprues and feed them right back into the hopper during the molding operation. Here again all scrap should be kept absolutely clean and free of contamination, particularly if it is of light color or transparent. In either case, it is often not wise to mold the reground with the virgin material. Mixing the two involves the risk of contaminating the new material with scrap which may not have been properly handled. If the reground scrap is not available in the shade of color desired in the finished article, a special paint may be sprayed or applied by dipping. Care should be taken to make sure that such paint or lacquer is compatible with the material used, because similar plasticizers in these coatings may later attack the plastics and cause them to soften and become tacky, although they at first appear to be satisfactory. Thermoplastic scrap may also be molded and coated with small amounts of sprayed metals (if available), yielding a metal finish. Some parts embodying scrap may be made satisfactorily in practically any color mixtures or mottles.

In a recent speech Floyd B. Odlum, director of contract distribution for the OPM, made the following observation: "The man in the business suit as well as the man in uniform is now fighting a battle of machines. . . . It means that your plant will be a very real part of our Army." Since every ounce of usable material will be needed in the war effort, no better New Year's resolution can be made by the plastics industry than to reduce waste to an absolute minimum.

Plastics

1

2

3

1 Dripless serving tops for syrup, cream or salad dressing pitchers replace metal die-cast products. Injection molded entirely of Tenite except for a tiny concealed stainless steel spring, the all-plastic top is a functional, decorative closure for a food product. It is unaffected by the contents of the pitcher, rust-proof, sanitary and easily cleaned. Molded by Chicago Die Mold Mfg. Co. Barnes & Reinecke redesigned the server for Federal Tool Co., changing the label and top but utilizing the same glass container

2 At the press of a button, a scientifically designed moisture register gives exact moisture measurement of lumber by direct dial reading. The device, which weighs only 5 lbs., is portable and has no points to break off or get out of order. A rugged molded phenolic housing, which protects the meter mechanism, is lightweight and better looking than the aluminum case it replaced. In addition, the plastic case reduced costs in production and assembly. Molded of Durez by Wilcox Plastics Molding Co. for Moisture Register Company

3 Trimly finished, sealed-in beam fog light for automobiles has a molded cellulose acetate rim of pale gray to match the enameled shell. The sturdy rim, formerly made in chromium, will not rust, stain, corrode or chip, and can be wiped clean. Molded of Lumarith by Universal Plastics Corp. Fog lights are produced by Yankee Metal Products Corp. and come with weather-resistant hardware

4 An evenly and completely illuminated sign on a Southern California Gas Co. building, requiring little maintenance cost, is economically produced from clear Plexiglas sheet. Letters are inserted into the face of a concrete building with lights behind them. Edge toward the lights is polished, the other three sides frosted, making a complete box of light. Steel forms were used to shape the letters. Male and female as well as side plates were required because of thick sections and comparatively sharp curves of letters desired. Where joining was necessary, clear transparent welding was done with glacial acetic acid. Produced by Hollywood Lighting Fixture Co., Inc. Designed by Jerome J. Rieldand and Robert V. Derrah, architect

5 Sample outlet box (center) is molded of Rexin-X Crepe—a resin-impregnated paper with all-directional stretch—by Cincinnati Industries, Inc. Two sizes of disks, shown in stacks,

4

5

in Review

form the charge for the piece which, although molded, has continuous and unbroken laminations in spite of vertical side walls, uneven wall sections, deep bosses and inserts and holes molded into the piece. Paper flows within the mold, completely filling all areas, resulting in a finished product claimed to have unusually high strength. Other two parts in foreground are experimental also

6

6 Nothing is quicker than the electric eye which sees and tells all. These photoelectric cell units are important cogs in the industrial wheel and can be used to count, sort, detect, control, select, measure, announce, regulate, compare, protect and perform an amazing number of "human" functions. The Eby electric eye shown is housed in a precision molded Durez shell which is non-corrosive, light-proof, unaffected by temperature variations

7

7 Transparent models of wrist-action electrical plugs, designed to eliminate cord trouble caused by kinking and twisting at the end, are molded of Lucite. They demonstrate the swivel action of the free-swinging plug. The actual utility cord sets are of high-heat resistant Bakelite phenolic. Molded by Davis Manufacturing Company

8 Thumb-sized midget switch made by Acro Electro Co. depends on molded phenolic for dielectric strength and exacting tolerances, for its friction less snap action operation. The switch is required to withstand 600 volts and will operate at 1800 makes and breaks per minute for extreme uses. Housing is molded in two sections by International Molded Plastics, Inc.

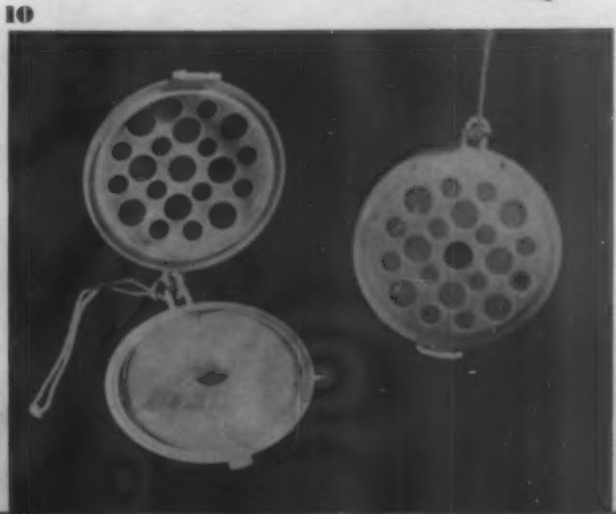
8

9 Stalwart lumberman or amateur craftsman will like the looks and grip of this light molded cellulose acetate saw handle—the color of California redwood. It is designed for comfort and durability and won't chip or scratch even in rough usage. Handles are of Lumarith made for a Montgomery Ward hand saw

10 Death to moths! Paradichlorophenol and other deodorants can be safely housed in durable, light ethyl cellulose containers. The material is odorless, moisture-resistant and will not be affected by the ingredients of the insect killers. Manufactured by Lapin Products Co. from Hercules Ethyl Cellulose

9

10



Stock molds

SHEET ONE HUNDRED-FIFTEEN

Household items are always excellent premiums. Coasters, clothes line reels, sterilizer bottle caps, and drink mixers meet the need for inexpensive gadgets which are available directly from stock molds without mold cost. Address Modern Plastics, Stock Mold Dept., Chanin Building, New York, giving item and sheet numbers

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1352. Comb and brush sterilizer; 10 1/2 in. overall height; 4 1/2 in. diameter. Has metal lift-out tray attached to cover by rod terminating in ball on top. Metal parts chromium plated. Cover and base contrast with body

1390. Ribbed coaster 2 3/4 in. diameter of bottom; 3 1/4 in. overall diameter across top; 1/4 in. deep

1391. Zippo self-winding clothes line reel in colors. Available in single and double 14 ft. strand construction. Diameter 3 in., 1 9/16 in. depth. Has loop for hanging, and hook on side for holding line making it easy to use

1392. Standard size milk bottle cap with metal clamp attachment on top and rubber sealing ring inside. Overall width at widest point 2 3/4 in.; approximately 2 in. deep. Pours without dripping

1393. Spoons for iced drinks 8 in. long; spoon area 3/4 in. wide at center

1394. Stirrers for drinks 6 1/4 in. long; 7 1/2 in. long; clear and opaque

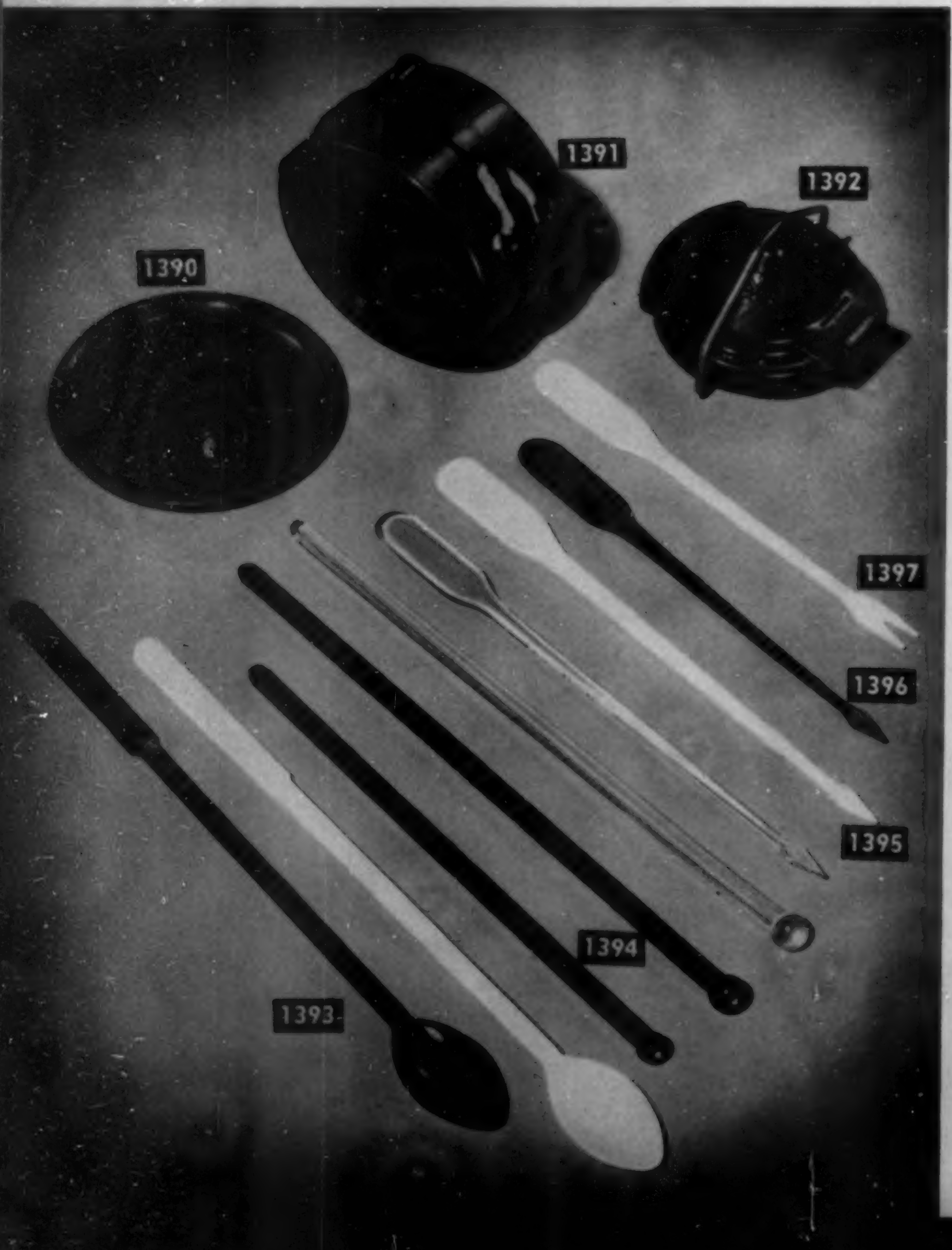
1395. Sticks for stirring drinks and spearing fruit; single point 6 1/4 in. long; clear and opaque

1396. Single point stick for stirring drinks and spearing fruit. 5 1/2 in. long.

1397. Double point stick for stirring drinks and spearing fruit. 5 1/2 in. overall length

All molders are invited to send samples from stock molds to appear on this feature page as space permits

Reprints of all stock mold pages which have been published to date with a complete index of suppliers are available in book form to Stock Mold Service subscribers



DR. GORDON M. KLINE, Technical Editor

Advances in plastics during 1941

General review*

by G. M. KLINE

THE keynote of the year in the plastics industry was, of course, the defense program with its attendant opportunities for expansion into new industrial applications and its disruption of many normal markets for plastics. Despite the general difficulty experienced in obtaining all the supplies of molding powders desired, preliminary estimates indicate that the materials manufacturers made about 50 percent more plastics in 1941 than in 1940. However, even this record-breaking production effort was not sufficient to permit realization of a goal set early in the year to relieve shortages in metals needed for defense by replacements with plastics, and the rapid development of demands for plastic parts to be used on military equipment quickly led to the establishment of preference ratings for deliveries of certain types of synthetic resins. As the end of the year approaches all plastics are under surveillance with an allocation program for practically all types in the offing.

The expanding outlets for plastics in defense were highlighted in the 1941 Modern Plastics Competition awards.[1] Airplane manufacturers used molded, laminated and fabricated plastics for outstanding developments in gun turrets, nose sections, cabin ventilators, aileron control quadrants, radio antenna masts, cabin paneling and flooring and fluorescent instrument panels. A plastic black-out glare-free lighting unit facilitates inspection work in defense factories. Extensive use of plastics in a radiosonde, which transmits records of pressure, temperature and humidity in the upper atmosphere, permits the more efficient attainment of data needed for long range weather predictions required in military and aeronautical work. Successful applications of plastics to even more direct and important items connected with defense were achieved late in the year and others are progressing satisfactorily through the experimental stages.

Materials

There were no outstanding developments in new plastics during the year 1941, inasmuch as all efforts were concentrated on increasing the output of established products. However, toward the end of the year considerable attention was devoted to the possibilities of certain natural products in extending the available supplies of molding powders. Of primary interest in this connection were furfural, lignin, soybean meal and bagasse. Producers and molders alike are accumulating a background of experience in processing these materials and a stage has been reached at which selection of particular formulations for concentrated commercial use is feasible.

* Presented before the Rubber and Plastics Subdivision of the American Society of Mechanical Engineers, New York, N. Y., Dec. 4, 1941.

Numerous articles were published regarding further developments in plastic materials and fillers. The use of urea resins as adhesives expanded[2] and melamine resins were employed in molding compositions as well as to a greater extent in protective coatings.[3] Cast phenolics in accord with the trend of the times took on industrial jobs such as forming tools in aircraft factories and parts for oil-well-drilling operations.[4] Many improvements were reported in reinforcing agents for use with phenolic resins, most of which were significantly directed toward boosting the toughness and impact resistance of the plastics to make them more suitable for rugged work. These developments related to the use of creped paper,[5] wood pulp,[6] glass fabrics and filaments,[7] sisal,[8] cottonseed hulls,[9, 10] metal powder [11] and mica[12] in plastic compositions. Resin-treated and compressed wood suitable for molding and fabricating into metal-forming dies and airplane propellers was described.[13] Further progress in the preparation of plastics from lignin[14–17] and soybean protein [18–19] was reported. Several surveys appeared regarding materials about which little had been previously published, namely: vinyl alcohol,[20] starch,[21] zein[22] and coffee[23] plastics. It can be assumed, however, that many new developments in synthetic resins were kept in the laboratory because of lack of plants and personnel to undertake their commercial production.

Molding and fabricating

Continuous extrusion has made phenomenal strides during 1941 and is providing plastics in decorative and structural shapes to replace aluminum, stainless steel and other metals reserved for strictly defense purposes. The process differs from the former technique employed in making rods and tubes in that the composition hardens simply by cooling whereas previously solvent had to be added to obtain proper flow and this solvent had to be removed in a seasoning process. Fairly intricate shapes can now be made on a commercial basis from the various thermoplastics, including vinyl resins, polystyrene and the cellulose compounds, and the process is being extended to larger and more complicated shapes as improvements in materials, machines and dies are effected.[24] Special awards were given in the 1941 Modern Plastics Competition for developments in extruded plastics for use as furniture and cabinet trim, interior decoration, window-trim, upholstery for transportation and theater seats and colorful fabrics of unusual strength and resiliency.

Fabrication of aircraft structures by the rubber-bag molding process has been the subject of many papers during 1941. Its successful operation in a number of plants in this country has demonstrated that it is a practical method for producing airplanes using materials and labor which are more readily available than those required for metal aircraft.[25, 26, 27, 28, 29, 30]

(*Please turn to next page*)

Applications

The aircraft industry continued to explore and utilize plastics in new ways during 1941. In addition to the items which received special awards as previously mentioned, other achievements in the fabrication of aircraft parts from plastics were reviewed by various authors.[31, 32, 33, 34, 35, 36, 37, 38] The use of resin-impregnated compressed wood for the mass production of propellers was of especial interest[39, 40] in view of reports from England of their continuing successful operation.

Resin-bonded plywood provided the answer to many problems arising in connection with shortages of materials in the defense program. It has been used extensively in defense housing and small boat construction[41, 42, 43, 44] and, as the pinch in steel becomes more acute, it is probable that this weather-resistant structural material will get further recognition in the defense industries.

There was considerable activity in the molding of plastic lenses during the year, particularly for gas masks and safety goggles and spectacles.[45, 46] Three patents were issued to one optical firm relating to molding and polishing plastic lenses.[47, 48, 49] A complete plastic contact lens for use without frames is also on the market.[50, 51, 52]

Synthetic resins became available in this country during 1941 for use in water softening and purification, recovery of valuable substances from solution, removal of dissolved salts from biological and pharmaceutical preparations, and other special applications involving separation of dissolved constituents from solutions. This function of synthetic resins as ion exchangers focuses attention upon their chemical properties in contrast to previous emphasis on strength, hardness, inertness and color. An extensive research involving synthesis of many different types of synthetic resins and development of a rapid method for evaluating their efficiency as exchange absorbents preceded the selection of the particular ion-exchange resins now in commercial production.[53, 54, 55]

Advances in the application of plastics in many industries were summarized in reports covering fluorescent lighting,[56] refrigerators,[57] wire covering,[58] records,[59] dentures,[60] wearing apparel,[61–62] automobiles,[63, 64, 65, 66] grinding wheels,[67] electroplating,[68] chemical filters[69] and chemical plant equipment.[70–71]

Testing and properties

Measurement of the flow of thermosetting and thermoplastic compounds at molding temperatures was the subject of seven papers published during the past 12 months.[72, 73, 74, 75, 76, 77, 78] These investigations included work with the flow tester used in the tentative standard methods of the American Society for Testing Materials as well as with several new devices developed for special purposes.

The flammability of plastics was considered by two groups of investigators. The results of round-robin tests performed by Committee D-20 on Plastics in developing its tentative standard method were described in one paper.[79] Comparative burning rates of various plastics were reported by the Underwriters' Laboratories in another publication.[80] Plastics, other than the pyroxylin type, were divided into three classes according to the latter bulletin, corresponding to noninflammable, self-extinguishing or difficulty flammable and slow-burning materials.

The dimensional changes which plastics undergo when subjected continuously to boiling water for long periods were tabulated in an important contribution from the Mellon Institute.[81] This paper provided additional information regarding the dimensional stability of plastics when immersed

Apparatus used by the National Bureau of Standards for testing color fastness of plastics, includes an ultraviolet lamp. This method has been adopted by the Army Air Corps and Navy Bureau of Aeronautics for testing aircraft plastics

in water to supplement that published late in 1940 by the National Bureau of Standards.[82]

A simple device for determining the flexural strength of plastics was described by the Soybean Regional Laboratory.[83]

Five papers pertaining to plastics were presented at the 1941 Annual Meeting of the American Society for Testing Materials. One of these related to a chemical method for detecting free phenol in closures which gave a satisfactory correlation with taste tests involving these closures.[84] Another pertained to tests made at the University of Illinois on the mechanical properties of cellulose acetate plastics, including tensile strength, elongation, tensile endurance limit and flexural fatigue properties.[85] Shear strength, creep and cold flow of various types of plastics were reported in two papers from the Plastics Industries Technical Institute.[86, 87] The resistance of plastics to immersion for a 7-day period in representative types of chemicals was the subject of a report from the National Bureau of Standards.[88] Weight and dimensional changes and effects of the chemicals on appearance or condition of the plastics were tabulated.

Six new tentative methods of tests for plastics, a procedure for preconditioning plastics for testing, and four revisions of existing tentative test methods for plastics were adopted by the American Society for Testing Materials.[89] The properties covered by these methods were color fastness, light diffusion, deformation under load, flammability, flow temperature, impact resistance, resistance to chemicals, optical uniformity of flat transparent sheets and tensile strength.

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Surface coatings

by W. T. PEARCE*

USES of alkyd and urea-formaldehyde resins were greatly extended. These include architectural, refrigerator, washing machine, Venetian blind and sign finishes. Due to the limited supply and high price of tung oil, high viscosity, rosin-modified phenol-formaldehyde resins were employed in increasing quantities with linseed, dehydrated castor and other oils, for the manufacture of fast drying varnishes and enamels. Paints made with alkyd resin emulsions went into wide use for interior walls and on the exteriors of masonry buildings. Low-temperature-curing urea-formaldehyde resins were widely adopted for furniture finishes.

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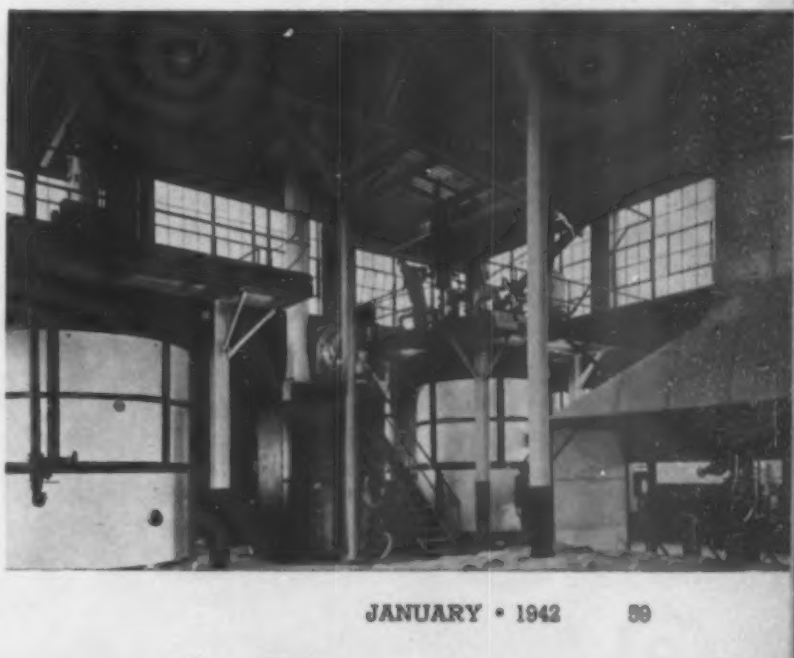
Most of these developments occurred during the earlier part of the year. Our developing defense and lend-lease programs caused many changes and some reversal of trends during the later months. Shortages in essential raw materials for synthetic resin manufacture developed, and the supply of all types of such resins became inadequate for the increasing defense and civilian needs. Mandatory priorities were placed on formaldehyde and phenol and the supplies of glycerin phthalic anhydride and maleic anhydride became restricted. Increasing quantities of alkyd resins were required for tank, battleship and airplane coatings. Federal, Navy and Army Departments used larger quantities of phenolic resin varnishes. In the latter part of the year oleoresinous varnishes were also employed to replace or extend alkyd resin solutions.

A survey of the literature reveals that, in spite of the existing emergency, many interesting developments in both raw materials and finishes occurred. The effect of the size and shape of pigment particles upon the properties of paints was investigated.[1] Tests revealed that the flooding of paints containing chrome-green in alkyd resin vehicles was reduced by the addition of soy lecithin, and increased by the presence of water.[2] Data from immersion tests showed that paints containing electrolytic flake copper and certain types of varnishes furnish good resistance to the fouling of ship bottoms by barnacles and tube worms.[3] The manufacture of rutile forms of titanium dioxide and titanium calcium pigments possessing improved hiding power was an important advance.

A very important development was the commercial production of faster drying oils from fish, soybean and linseed oils, and the use of such oils in fast-drying varnishes. By processing with high-viscosity phenolic resins, varnishes of satisfactory drying, water and alkali resistance are secured. An interesting study was made of the relationship of the structure and position of the substituent groups in phenols to oil solubility, color and other significant properties obtained in resins in which they are used.[4] The commercial development and use of melamine-formaldehyde resins represented an important advance in the formulation of baking finishes. They are used with alkyd resins, to produce faster curing finishes

Typical processing equipment used for producing alkyd resins which are widely used in synthetic coatings

PHOTO, COURTESY REICHHOLD CHEMICALS, INC.



of superior color and gloss retention.[5] By the use of pentaerythritol in place of glycerin, esters of rosin were prepared which are higher in viscosity and impart to oils fast-drying and water-resisting characteristics.[6]

Extensive investigations were made upon methods for producing fast-drying, water-resistant varnishes without the use of tung oil. Varnishes of all important types were formulated, employing the high viscosity phenol-formaldehyde and maleic anhydride resins with linseed, dehydrated castor and other oils. Such varnishes proved to be satisfactory for many purposes.[7, 8, 9]

It was found that electrolyzing voltage breakdown tests aid in determining optimum film weights for many types of resin coatings. The resistance to film failure by impressed voltage potentials varies directly with the film thickness above the threshold thickness for film continuity.[10] Work was continued on the study of deterioration of paint films. Glyceryl esters of oleic, linoleic, linolenic and elaeostearic acids were used in an investigation of changes resulting from exposure to ultraviolet light.[11] Ovens employing infrared lamps were developed for baking finishes.[12] This method of heating by radiation produces very much faster curing.

Luminescent paints for use in "blackout" areas attracted attention, and methods for producing phosphorescent pigments and paints were developed.[13, 14, 15]

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Molding presses

by E. S. WALKER*

THE trend toward completely automatic molding has continued to gain momentum during the past year. This is largely attributable to numerous improvements in machine design, resulting in higher output and greater efficiency. Speed of press operation has been stepped up 25 percent, resulting in substantially increased output per unit mold cavity.

New, more accurate feed devices handle a wider range of materials. Molds and machines are safeguarded against accidental damage by improved, highly sensitive traps or checking devices which stop the press should a piece stick in the mold and fail to eject. Indicating lights have been placed on thermostats. A device for counting the number of molded parts is now standard equipment. Higher wattage heating units and improved insulation of heating plates bring the presses up to heat more quickly and result in lower current consumption. Larger air lines and valves plus a new type "knock-off" make ejection more positive.

Such improvements are of more significance than may be apparent, the proper functioning of an automatic machine being wholly dependent upon the effectiveness of each individual part or control. Less than 100 percent efficiency in any small detail is reflected directly in the efficiency of the entire press.

Due to past limitations manufacturers have held to low operating pressures. Of the 400 or more general-purpose automatic molding machines in active service, practically all are of 10- or 15-ton capacity. Recent improvements not only permit the use of somewhat higher pressures and the molding of parts larger than heretofore, but also safely permit the use of molds with greater numbers of cavities.

Completely automatic presses for molding thermosetting resins take on added significance at this time in view of their role in the defense industries. Shortage of skilled press labor is becoming an increasing problem. In this respect automatic molding machines help in relieving the pressure. Naturally, they are not a cure-all. The scope of work that can be handled is difinitely limited. Nevertheless, there are thousands of small parts which are now being molded conventionally which could well be run without manual attention. By conversion of such parts to automatic methods, operators may be relieved for other duties for which they are essential.

One of the production bottlenecks lies in a shortage of skilled die makers. Here the automatic press works to particular advantage by using molds with few cavities. Present die-making facilities may be put to more effective use by curtailing the demand for large conventional multiple-cavity molds, thus relieving tool makers for other operations. Speed of mold delivery is another factor. Small automatic molds can be produced in substantially less time than that required for large conventional molds. Molds can be placed in operation and parts produced in advance of large manual set-ups.

Probably the most important machine development in the past year lies in a new press for molding threaded articles. It is completely automatic, one operator attending a battery of units. The unscrewing and ejecting principle is ingenious, and comparatively simple. Two basic steps are involved: first, simultaneously breaking adhesive contact between molded article, force plug and cavity; and second, wiping the loose article from the thread forming member. In this press an automatic preform loading device supplies ball-shaped pellets to the lower die plate. All operations including loading, closing, opening, unscrewing and ejecting, but exclusive of cure, require only 8 seconds. The number of mold cavities is limited only by press capacity (50 tons) and changeover from one mold to another is accomplished rapidly. This development promises to have far-reaching effects in threaded-cap molding and is expected to reduce production costs.

Group of 15-ton automatic compression presses with triple feed device, made by F. J. Stokes Machine Co.

* F. J. Stokes Machine Company

Another development this past year is a new semi-automatic button-molding press. This machine is designed to cut labor costs in half, time-saving devices enabling one operator to run two machines instead of one as heretofore. Quick opening and closing, simultaneous loading and ejection and new automatic controls all combine to speed up operation and increase output. The complete machine consists of two independent units: a special 150-ton, self-contained, toggle-type hydraulic press and an automatic preform loading device. The operator's main function is to pick up a fully loaded tray of preforms from the loading device and place it on a sliding frame which is a part of the press. As frame and tray are momentarily pushed forward into the machine, the molded buttons are blown back into a chute while the empty cavities are simultaneously reloaded. By pressing a starting button, the machine then automatically closes, breathes, cures, opens, and finally lifts the finished buttons from the mold cavities.

Resin plant equipment

THE past year has brought no single radical departure in the design of resinification equipment or the incidental control instruments. The main problems demanding solution were those concerned with shortage of construction materials and fabricating delays due to priority demands of the defense program.

As in previous years, the preferred materials of construction for resinification equipment were steel, stainless steel 18–8, chrome steel, aluminum and glass-lined equipment. Some shortages in the nickel, chrome steels and glass-lined equipment have caused very serious delays in equipment fabrication.

More efficient and more productive equipment is becoming available based on constant, if gradual, improvement in design. Advances along this line have been accelerated in the past few years and will probably go ahead even more rapidly in the immediate future. This is true since information on various reaction data and physical and chemical constants has been crystallized to such an extent that engineering calculations based on them now have a high degree of accuracy.

With the great, and increasing, production of all synthetic resins and plastics and the consequent considerable reductions in sales price, advances in resin plant design to obtain economical and quality production are becoming even more imperative. From data at hand it appears that the manufacturers of such equipment are entirely aware of the situation. Equipment to give optimum performance as far as the major factors are concerned is now available. Designs to meet foaming problems, correct heat transfer, refluxing, condensing and other problems are now commercially available. Improved auxiliary devices, as inert gas producers for use in maintaining color control in any production capacity desired, raw and finished materials conveying and receiving equipment and other adjuncts can now be obtained.

Design improvement is also taken to include equipment space, location and connections. In one of the major new installations of the past year, the location and relation of the component parts represent the type of plant needed today for economical production of large tonnage lots of phenolic resins. Among the striking features of design in that plant is use of the metal flooring instead of receiving pans for the finished resins. Such an item is cited as evidence of the forward steps now being taken to entirely remove synthetic resins and plastics from the field of specialty chemicals into that of industrial chemicals.

Increased utilization of continuous resinification equipment is the ultimate goal of all resinification procedures. Most of the present success has been with hydrocarbon polymerization, such as coumarone-indene polymerization. Advances have recently been made in other fields, e.g., polymerization of styrene and vinyl esters.

Mechanical and structural refinements of equipment now in use include changes in methods of heating, improved stirring, more efficient charging and discharging outlets. As specific examples may be mentioned: (a) New type outlets were designed and installed to permit satisfactory withdrawal of molten amino formaldehyde resins having a viscosity far in excess of any such resin previously manufactured; (b) the installation of closer scraping stirrers in resinification equipment now in use reduced the number of shut-downs for clean-out by several hundred percent.

PHOTO, COURTESY SYNTHANE CORP.

Sheets assembled for laminating are cured under heat between polished steel plates, in a large hydraulic press

Laminates

by S. W. PLACE*

IN the history of laminated plastics, 1941 will be better remembered as a year of extensive application rather than of intensive research and development. The impact of war production needs has greatly increased the demand for laminates, not merely to make up for the shortages of certain metals, but for those applications in which laminates were already vital—in aircraft, for example, and in tanks, guns and military communication equipment. Some of the recent developments of the last few years which enjoy an ever-widening market are summarized herewith.

Coil forms for radio receiver permeability tubing have low moisture absorption, dimensional accuracy and stability, coupled with high strength in thin walls (.008 in. and up) as

* Synthane Corp.

well as good electrical properties. Combination laminate-rubber is used in various build-ups or sandwich-layer construction for shock absorbing applications. It may be used as a seal for the terminal washers on fixed condensers by placing the rubber inside. Combination laminate-fibre materials are used where resistance to the effects of an electric arc is needed.

Various processing solutions such as photographic chemicals or those used in processing synthetic yarns may be advantageously piped in special grades of laminated phenolic tubing when corrosion resistance presents a problem. Laminated phenolics are successfully used in electro-plating processes for plating rack coverings, insulators and supports. Laminated phenolics are also used in the manufacture of plating barrels, plating and cleaning baskets, splash shields, plating masks and sand blast shields. Laminated phenolics are utilized for plating tank parts, in applications such as baffles, insulators, supports, liners, air agitators and piping. In aluminum anodizing special grades of laminated tubing in the form of cylindrical containers are employed. The containers must be well reinforced and highly corrosion-resistant to withstand severe mechanical stresses caused by the "packing" necessary to insure good electrical contact between parts being anodized. These barrels have a life of several years. They outlast any other suitable insulating material and conserve aluminum, the only metal which could be used. Aluminum, however, has a very short life in this application.

The addition of graphite in quantities up to 10 percent to the phenolic resin has been found to give self-lubricating properties to the material. Among the many applications for graphitized laminates are light bearings, cams, rollers and pump rings.

New uses are constantly being found for molded parts requiring greater strength than can be obtained with the usual powder molding. The use of molded-laminated construction, i.e., impregnated laminations cut to fit a given mold, or molded-macerated construction where the impregnated fabric base is chopped up into small pieces and placed into the mold, represents two methods of molding parts which have much higher tensile and impact strengths than powder moldings. Successful applications of molded-laminated and molded-macerated construction include truck wheels, hand wheels, pulleys, foot-valves, breaker arms, gears, pipe fittings, wash chucks, spinning buckets and airplane fair leads. These are considerably cheaper to mold than to machine from laminated sheet, rod or tube material and have the advantage of finished surfaces of better appearance.

The use of a molded-macerated ball as a foot-valve has been found advantageous for sealing oil wells. In this application, the well is sealed by placing the ball in the bottom of the casing and sealing it in with cement. To open the well, the ball is drilled through.

Many automotive engineers specify laminated phenolic washers with ground surfaces for water pump seal washers and for thrust washers. Such applications require the use of better than average grades of fabric base materials.

Manufacturers of fine precision machines are finding more uses for laminated phenolics as silent gears, pulleys, clutch rings and hand wheels. The advantages of laminated phenolics in these applications are extreme lightness of weight ($^1/_2$ that of aluminum), high tensile and impact strength, low modulus of elasticity and excellent wearing qualities due to resilience and quietness of operation.

In addition to the use of laminated phenolics for bobbin spools, the past year has seen the development of laminated phenolic bobbin adapters. These adapters are slipped over smaller spindles to permit the use of larger bobbin spools, thus increasing the effective usable range of bobbin sizes.

During the past several years useful data about the properties of laminates have been obtained by the joint efforts of consumers and producers working together through the medium of the American Society for Testing Materials. Tests for impact fatigue strength, made by repeated blows on laminated phenolics, better simulate actual service conditions than an impact test which breaks the piece in one blow. The impact-fatigue test has demonstrated that the material having the highest Izod impact strength is not necessarily the best for impact fatigue strength. Other active subjects under investigation at the present time include shear strength testing; measurement of cold flow; resistance to effects of heat, light and chemicals; methods of measuring *modulus of elasticity* or *stiffness factor;* and methods of testing plastic bearing materials.

Phenolic resins

by A. J. WEITH*

THE year 1941 has seen radical changes in the uses to which phenolic resins are placed. As the year progressed there has been a rapid and continuous change from uses predominantly civilian to defense demands. In the latter months this pace has increased rather than slackened. Thus, early in the year we heard much of the use of plastics, particularly phenolics, to replace metals. As the year passed this changed to the necessity of using plastics only where absolutely necessary. This change was due not only to the limited supply of plastics but more to the realization that such materials have inherent properties which fit them into uses which cannot be filled by other materials. In other words, even those who are unfamiliar with plastics are coming to realize they are not substitutes. The impact of this change-over was felt first by the laminators.

This was natural since parts made from laminated material are generally stronger than those made of molding material. Many of their standard shapes and forms fitted directly into defense demands. However, in addition, much

* Directory of Research and Development, Bakelite Corp.

Fillers, coloring material and phenolic resin are mixed on heated compounding rolls and cure of the resin advanced for rapid molding

PHOTO, COURTESY BAKELITE CORP.

progress has been made in producing a variety of shapes and forms which were previously machined from flat sheets. This has tended to lessen the difference between the operation of the laminator and molder.

Fluorescent and luminescent laminated has been developed and is finding many uses. Decorative effects, achieved both by colors and indirect fluorescent lighting, have produced beautiful products of excellent utility and distinctive design. Luminescent laminated has been especially effective for signs and signals. These developments offer a means of ready visibility at short distance.

An unusual use of molded-laminated has been found in the forming of asbestos shingles. Molds for this purpose are now made of laminated phenolic. This use indicates the way to other fields.

Allied with the laminating industry has been the plywood and impregnated wood work. Phenolic resins continue to give the most moisture-resistant and serviceable plywood bonds. The development of light and medium planes, gliders and boats has pointed the way to the wide possibilities in this means of fabrication. Impregnation of the wood with a suitable resin before bonding improves moisture resistance still further and also strength across the grain. The resulting impregnated wood can be densified and laminated by hot pressing. Thus, an extremely dense strong piece can be obtained. Very heavy sections may be made by bonding of several thinner pieces in much the same way that built-up parts are made by gluing of wood. Wide developments in this field are expected.

One of the developments which has reached large proportions during the year is washing machine agitators. It presages other large uses when molding materials are again available for general consumption. In this instance, the plastic won in direct competition with a metal on the basis of greater utility and lower cost.

Another development, which is not new, has come forward rapidly during the year. This is the use of resin-impregnated paper or rag-base board for molding purposes. The excellent shock resistance of such materials is due not only to their long fiber but also to the interlaced nature of these fibers. Handles for a variety of instruments have been molded. Their use as cut-out forms to brace weak sections of regular molded parts has also been employed to great advantage. Points of high stress may thus be strengthened without recourse to an impact type material, which, in many instances, would mean rebuilding of the mold.

Sisal-filled products have been offered during the year. The great toughness inherent in this fiber is imparted to the molded piece. Interlacing of these fibers gives still greater strength where the application permits the use of such a prefabricated form. The known tendency of sisal fibers to absorb moisture and swell is stated to be no obstacle to use in certain applications.

Urea-formaldehyde resins

by M. H. BIGELOW*

TRUE to the prediction of the last year, urea-formaldehyde resin production was substantially increased in 1941. Unfortunately, the shortage of formaldehyde curtailed urea resin production somewhat below capacity with the result that the entire poundage necessary for national defense and essential articles for civilian use could not be manufactured. Compliance with the General Preference order M-25, allocating formaldehyde, issued by the Office of Production Management, quite radically changed the fields of application of urea molding compounds. More than ever before urea plastics have been used for their electrical and physical properties rather than their fine colors.

With the shortage of metals, engineers turned to plastics for assistance and ureas received their share of attention. If there had been no shortage of raw materials and if the plastic plants had had the facilities for producing, the amount of ureas which could have been used this year staggers the imagination. Had the raw material been sufficient it is still questionable whether the molders could have tooled up to handle the volume of business. As it stands now some molders, who specialized in certain fields of activity, are practically at a standstill. With radio cabinets and cosmetic containers in Class II, and hardware and household items in Class III, certain producers were practically shut down overnight. Those that had a wider diversity of application faced curtailment but of a milder degree.

It is difficult to enumerate the advances of urea resins without divulging information which at this time is best left in military circles. Nevertheless, certain pertinent items may be mentioned which indicate the general trend in urea plastic usage.

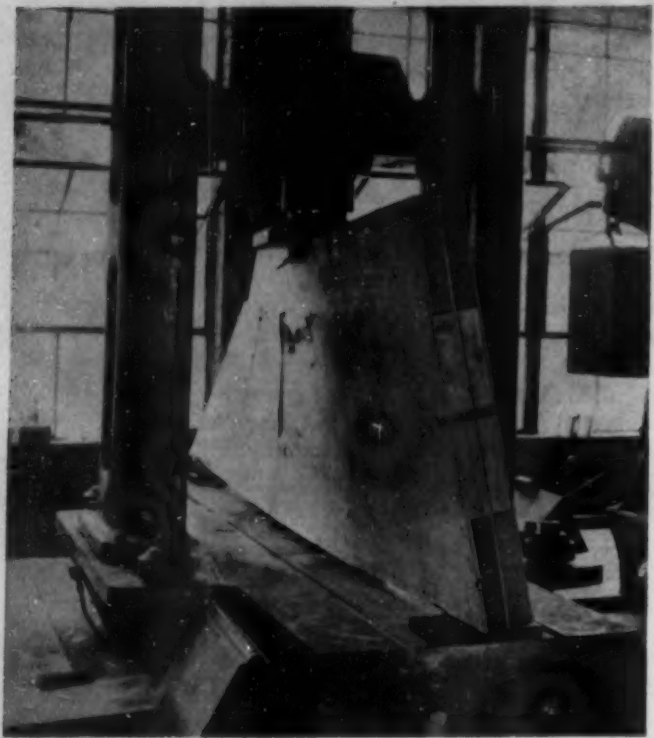
Molding compounds

Some of the new applications this year are outstanding. Ureas entered the field of surgery and achieved immediate notice with the development of the *surgical peep window*. This is a molded circular collar fitted with a removable cap. The surgeon, in binding up a wound which may require frequent attention, places one of these collars over the wound and holds it in place with bandaging. At any time he can lift off the lid and observe the condition of the wound. In bombshelled England the physicians were quick to adopt this surgical aid, and quickly pronounced it an important aid to medical science. This represents a new departure in surgery and bespeaks a lively future for such applications.

For those who classify urea plastics as decorative and suitable mostly for gadgets, it must be somewhat of a shock to see ureas take their rightful place due to other properties besides color and appearance. The new *radiosonde* is just such an application. Here urea plastics enter the field of the serious science of meteorology. Ureas, graduated from simple thermometer cases to the essential precision parts of a device very necessary to aviation—weather indicators. The radiosonde, designed and produced by the Washington Institute of Technology, is sent aloft by balloons which release the instrument by bursting. As they ascend and subsequently parachute to earth, a complete weather report, including temperature, barometric pressure and humidity, is broadcast to the airport by an ultra short wave radio set contained in the instrument. These balloons and attached equipment ascend some 12 miles prior to bursting and a radio signal is sent out every 200 to 300 feet. The signals are received and automatically recorded by special receivers. Urea plastics were chosen for this application because they are strong, light weight, poor heat conductors, and change dimension only very slowly with severe humidity changes.

In 1941 urea plastics were used for telephone relay segments. Use is made of physical strength combined with excellent electrical properties. These relay parts have been tested and tried under all extremes of temperature and

* Plaskon Co., Inc.



PHOTO, COURTESY U. S. PLYWOODS CORP.

Testing plywood beam assembled with Weldwood urea-formaldehyde resin glue showed 100 percent wood failure and no traces of glue-line failure under nearly 62,310 lb. pressure applied midway in a 10-ft. span

humidity and found satisfactory. Many similar applications were forthcoming this year.

In lighting there was a threefold increase in the number of fluorescent tombstone sockets molded of ureas. In addition, urea plastics this year were used for diffusors for fluorescent tubes. Several commercial units appeared on the market and were enthusiastically received not only because of their appearance but because of efficient operation.

The mechanical strength of ureas justified their use for casters and for the first time molded urea plastic casters were used commercially and with complete success.

Adhesives

During 1941, more than in previous years, urea resins found increased application in fields other than molding compounds. Greatest advancement took place in urea adhesives whose phenomenal increase has been outstanding. While national defense production has absorbed most of the output of resin glue, the merits of such adhesives insure their use for civilian consumption when defense activity subsides. For some time urea adhesives have been established in the cold and hot press fields and they are practically without competition for the production of formed plywood. This is because of the introduction of a low temperature hot press (212 deg. F.) glue which has a long assembly period. This adhesive was developed for such processes as are used in the Vidal, Duramold and Timm methods of fabricating formed plywood fuselages and wing sections. This glue, together with urea cold-setting glues the most satisfactory glue for assembling purposes, fill the requirements for modern wooden airplane and boat construction. The Anson bomber is equipped with a urea-resin-glued formed-plywood nose. Urea glues are certified for the manufacture of commercial planes, and have received the approval of civil and military authorities of the United States and Canada.

Coatings and finishes

Urea resin modified alkyd surface coatings were introduced a few years ago. This year the chief advancement in this field has been in formulation for specific applications. A better understanding of the chemistry of organic-solvent-soluble urea resins enabled the production of a wider variety of types. While previously used on automobiles and household appliances, these coatings are now applied to paper in the manufacture of bottle cap liners, floor and wall coverings and food containers.

The use of urea resins for textile finishing and paper treating has been limited by OPM order M-25, since both of these items were put in Class II. Wet-strength paper, where used for food containers, continued to be an outlet for urea syrups. The merits of urea-resin-treated paper will insure resumption of increased production when the resins become available.

High impact plastics have in the past been limited to the phenolics. During 1941, high-impact urea-impregnated canvas materials were made available. In contrast to high-impact phenolics which are molded into shape under high pressures and temperatures, these new urea-treated fabrics are formed under low pressure and temperature using cheap wooden molds. They combine the good properties of both the fabric and the resin. To date this material is limited to war use and actual applications cannot at this time be divulged. However, when times return to normal, a new and well proved construction material will be available.

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Thermoplastics

by JOHN M. DE BELL*

BETWEEN greatly enhanced industrial demands and replacement of scarce defense items, thermoplastics experienced extraordinary increase in 1941, approaching 100,000,000 lbs. in output, of which about 60 percent were cellulosics. Outstanding features of the year were the enormous increase in acetate molding powder to nearly 30,000,000 lbs.; more than twofold gain in the vinyls; almost doubled output of styrol, methacrylate and polyamids with new large capacities planned; and continued fear of shortage of materials. At the close of the year the supply situation would not appear too ominous save for the probability of a very serious shortage in cellulose acetate plasticizers.

With such feverish pressure for production, there was little opportunity for the introduction of novelties. Nevertheless notable gains were made in the field of continuously extruded plastics[1] and many manufacturers now supply strip for architectural trim and shapes of very complicated cross section for wall moldings, the edges of furniture and similar uses including various ingenious means of attachment. The demand for parts of high dimensional stability under various conditions of humidity has greatly increased the use of cellulose acetate butyrate and vinyl chloride-acetate; and there has been considerable influx of higher acetylated cellulose acetate. On account of the great scarcity of phenol-formaldehyde plastics especially for the lower bracket civilian uses, a certain amount of substitution for thermosettings helped swell the poundage of cellulose acetate. In the case of the other cellulosics, nitrate use was slightly higher but ethylcellulose, although produced in record quantities, was not greatly applied as a thermoplastic on account of the requirements for flexible lacquers.

In the cellulose acetate sheet field, a louver type of material controlled glare in lighting. Thin extruded monofils were used most effectively for weaving into decorative fabrics, wearing apparel and even belts.[2] Note was made in Great Britain of the application of corrugated sheet as heat insulating material[3] which would appear to be doubtful from the economic standpoint; and large demand for eye shields, especially in preparation for the possible use of military gases.

Methyl methacrylate continued to furnish the bulk of transparent parts for airplanes[4] but, in spite of the great demands from this field, substantial advances were made in the use for brushes, artificial teeth, inlays and crowns (in addition to the denture plates previously used),[5] improved reflecting signs and contact lenses.[6] Fruit and cake knives with serrated edges have become well established.

The almost tripled consumption of polystyrene has been the result of the larger refrigerator application chronicled last year combined with new defense uses where the radio frequency electrical characteristics were required. This has resulted in production of large pieces several feet long and up to 6 in. in diameter.[7] Papers by Marvel and his collaborators and by Kropa and Barnes[8] seem to indicate that the previously accepted structure for styrol polymers was incorrect and that chain bonding occurs between the aliphatic carbons adjacent to the ring, with the second aliphatic carbon appearing merely as a substituent methyl group.

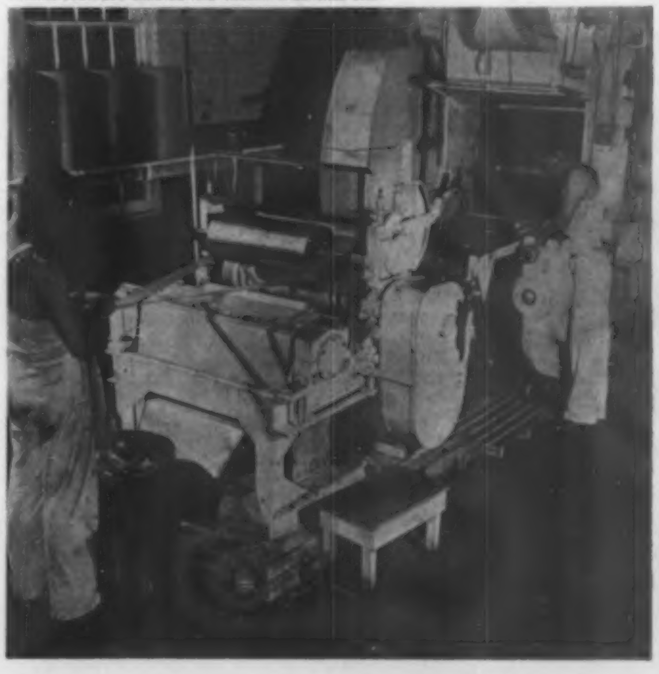
Vinyl chloride polymer and copolymer production has increased greatly, to satisfy the enormous demand for military electrical insulation, aircraft parts, and protective coatings.[9] In spite of the chlorine stringency, the established markets in general have been quite well maintained. Outstanding developments are scuff-proof shoe tops, heat-sealed raincoats, shower curtains and elastic molding compounds.[10] Filter cloths from Vinyon, a synthetic fiber of the same material, have been doing yeoman service in chemical resistance applications.[11] Polyvinyl alcohol[12] is continuing to find limited application against non-polar materials such as gasoline and has been proposed for grease-proofing.[13] Polyvinyl acetate is moving in considerable poundage in fields related to adhesives and partial acetates have also been advanced for this type of application.[14] Both the acetate and acetals are under active consideration for bullet proof gas tanks; and by the simple expedient of extending the interlayer of safety glass plastic well beyond the edges of the glass, improved attachment of safety glass has been secured especially for military uses.[15] The whole field of unsaturate copolymer resins is receiving much investigational attention with the object of eliminating characteristic shortcomings of materials now available.[16]

Heat-sealing characteristics of rubber hydrochloride have led to the development of very cheap and effective means of making lined paper bags:[17] in one case the coated or interleaved sheets are stacked in packs and the containers are completed merely by exposing the edges of the packs to a hot surface! In spite of the stringencies in phenol, the polyamid resins continue to grow at an enormous rate with an estimated capacity of 16,000,000 lbs., mostly for yarn, indicated for next year. Service tests from industrial brushes have been markedly successful[18] and of course the bristle and textile fiber uses are now completely established.[19]

In the newer thermoplastics, polybutene is finding good use as electrical insulation, coated fabric and adhesive. Polyethylene, which in the case of very high polymers gives excellent flexible electrical insulation of favorable loss characteristics, has been introduced in commercial amounts from England and has evidently received considerable research attention both as a polymer and copolymer.[20] According to the patents, the very high molecular weight material is made

Forming vinyl acetal interlayer for safety glass in continuous sheets on large calendering machines

PHOTO, COURTESY CARBIDE AND CARBON CHEMICALS CORP.



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under extremely high pressure. Resins derived from imines and from unsaturated esters such as fumarates and maleates have received patent attention.[21] Abroad, especially in Germany, it appears that considerable emphasis is being laid on after-chlorinated polyvinyl chloride and its copolymers for general plastics use. Thermoplastic ligno-cellulose is being further studied;[22] and some attention has been paid, both in this country and in Russia, to resins in which silicon enters into the main structure.[23] These should probably be classed as thermosetting rather than as thermoplastic.

The burning question for the coming year is, of course, the supply of raw materials. Barring unforeseen circumstances, the situation is now reasonably hopeful except that great stringency may develop in the phthalates on account of the export of phthalic anhydride; and it will probably be increasingly difficult to get molding equipment or steel for molds. Mandatory allocation for thermoplastics is practically arranged but it is hoped that it will be so administered as to cause a minimum of distress in those plastics where the supplies are nearly adequate for the demand. Since in some civilian classes it is permissible for a manufacturer to fill orders from raw materials which he himself manufactures without requirement to furnish the same raw material to the industry in general, it is expected that a certain amount of vertical integration may take place with a gradual tendency for fabricators to make a few of the non-patented molding powders they use.

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Polystyrene

by J. L. AMOS*

DURING 1941 the Dow Chemical Co. expanded its styrene and polystyrene production, and in addition the Barrett Co. and the United Gas Improvement Co. started furnishing plastic manufacturers styrene monomer recovered from by-product light oils produced in coke and artificial gas processes. The Catalin Corp.[1] recently entered the polystyrene field with a product called Loalin.

New developments in the production of styrene monomer during the last year consist mainly of methods of purifying and inhibiting the polymerization of this product. Patents have been issued covering phenylacetylene,[2] methyl aniline,[3] quinone[4] and aliphatic hydrocarbons[5] as inhibitors for styrene monomer for preventing polymerization at atmospheric temperature during storage or shipment. Sulfuric acid is claimed as a refining agent for removing α-methyl styrene from styrene.[6] Phosphoric acid,[7] activated charcoal,[8] potassium permanganate,[9] sulfuric acid,[10] sulfuric and boric acids,[11] benzene sulfonic acid,[12] formic acid[13] and sulfuric acid plus potassium dichromate mixture[14] are claimed as refining agents for removing color-forming chemicals from impure styrene monomer. A new method of purifying styrene monomer is described whereby a polymerization inhibitor is present in the still pot and column during its vacuum fractional distillation.[15]

An outstanding advance in the commercialization of styrene interpolymers in America was the announcement[16] that the Federal Government has authorized U. S. Rubber Co., Goodyear Tire and Rubber Co., Firestone Tire and Rubber Co. and the B. F. Goodrich Co. to build and operate for the Government plants to produce a styrene rubber-like interpolymer. New styrene interpolymerization agents are vinylpyridine,[17] 2-methyl acrolein[18] and cinnamic acid.[19] A new method of purifying polystyrene with butanol is claimed.[20] A new method of comminuting styrene copolymers has been described.[21] A method is claimed for polymerizing styrene in a by-product light oil fraction.[22] Products used as softeners or intermediates in the manufacture of artificial resins are claimed to be produced by polymerizing styrene in the presence of aromatic hydroxy compounds with acid polymerization catalysts.[23] An improved polystyrene is claimed by eliminating the methanol soluble material in excess of 3 percent, by weight, from it.[24] Liquid polymers of styrene are suggested as plasticizers and are produced by polymerizing styrene in the presence of activated bleaching earth catalysts.[25] A new method of forming colored polystyrene by polymerizing styrene in the presence of copper has been described.[26] A new method is claimed for forming liquid polymers of styrene by polymerizing styrene in the liquid polymer containing activated decolorizing earth.[27]

Several recent improvements in methods of fabricating and applying polystyrene have been reported. A method of impregnating wood veneer and molding the superimposed impregnated sheets into a plywood structure has been described.[28] An improved electrical tape insulation containing polystyrene is claimed, which can be heated to 120 deg. C. before becoming sticky.[29] Tougher and stronger compression moldings of polystyrene are claimed when the molding is done below 150 deg. C.[30] A method is described whereby bubble-free moldings of polystyrene can be produced.[31] The outer sheath for electric cables is claimed to be produced by polymerizing 20 parts rubber with 80 parts styrene monomer and then compounding the polymerizate with 20 parts isobutylene polymer and 40 parts of talc. This type of insulation is being used in England.[32] Polystyrene is used in forming insulating joints on metal-sheathed electric cables.[33] Swelling polystyrene in acetone, applying product to electric wire and removing swelling agent is claimed as new method of applying this insulating material.[34] A method has been described for making polystyrene type moldings by partial polymerization to a thermoplastic state, molding and then completing the polymerization.[35] A method is claimed for making printing plates from interpolymers of styrene-acrylonitrile or styrene-methacrylonitrile.[36]

The literature of 1941 describes many interesting properties of polystyrene. The flow properties of this plastic have been compared with other plastics.[37] The theoretical aspects of high polymer reactions have been published in book form.[38] The physical properties of polystyrene at temperatures as low as −25 deg. C. have been presented. At low tempera-

* Dow Chemical Co.

tures polystyrene becomes tougher and stronger. These advantages coupled with high dimensional stability have led to the use of polystyrene in injected molded interior parts for refrigerators.[39]

During the 1941 MODERN PLASTICS COMPETITION, ten objects containing polystyrene received first awards and two objects honorable mention awards.[40] These new uses for polystyrene consist of interior parts for refrigerators, containers for radio and Acousticon storage batteries, perfume containers, plastic radio mast stanchion for military aircraft, clarinet reeds, polystyrene tile, Dura Linx rosary, fruit juice extractor, radiosondes—instruments for making weather predictions—plastic syphon and transparent plastic geometric figures. Two recent outstanding applications for polystyrene were in the Philco refrigerator evaporator frame which is the largest injection molded piece ever made in the United States and the injection molded plastic radio mast stanchion for the cannon-carrying Bell Airacobra airplane. These uses show how readily polystyrene can be used in the injection molding technique of plastic fabrication. Celluplastic Corp. has announced[41] that threads, ribbons, rods, nosing, coving, piping, trim and many other shapes can be produced by the continuous extrusion of polystyrene. Pierce Plastics[42] have announced the production of polystyrene tubing and special shapes. These extruded shapes are taking the place of metals which are vital to the defense program.[43] Plax Corp. has made available to the plastic users polystyrene shapes and films which have high flexibility, i.e., polystyrene electric spaghetti insulation which can be cold formed at right angles without breaking.[44] The British are using plastic goggle and spectacle lenses for military use fabricated from polystyrene which have been given a special treatment to provide scratch resistance.[45]

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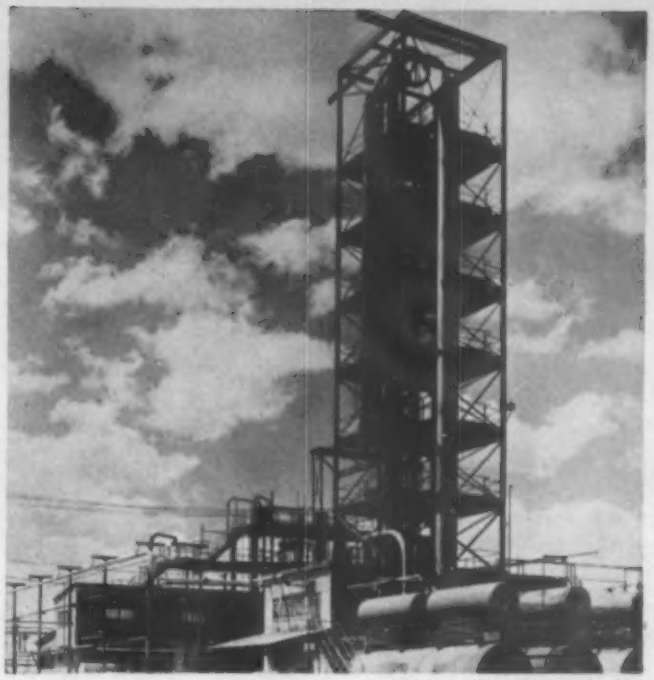

Exterior view of tower and storage tanks of a styrene resin plant

Vinylidene chloride polymers

by W. C. GOGGIN*

MORE complete information on the properties of vinylidene chloride copolymers including the outstanding properties of chemical resistance, high tensile strength and toughness was made available in 1941.[1] Many developments of commercial significance based on vinylidene chloride copolymers have appeared in the patent literature.[2]

Using modified conventional extrusion methods, a variety of types and sizes of tubing has appeared. This tubing has found many new uses, but those places where it has replaced copper, brass and stainless steel are of timely significance. Interesting applications of this nature are humidifier supply lines, air and water lines, chemical process tubing, instrument lines and oil lines. While a thermoplastic tubing of this nature has limitations on its operating temperatures, its properties of chemical resistance, high bursting strength, flexibility and long fatigue-life, enable it to be advantageously used in many applications. The tubing is so designed that at room temperature it can be flared with simple equipment in order that it may be joined with standard couplings and other type of tube fittings. A special metal fitting has been developed which does not contact the tube contents.

The use of orienting equipment in conjunction with standard plastic extrusion units makes possible the production of strong monofilaments and cane-like sections. Narrow webbing, braid, woven broadloom and knitted goods have been produced. These items find application in wearing apparel and accessories, draperies, upholstery, filter fabrics and ropes.

The injection moldings produced from vinylidene chloride copolymers have been used largely (*Please turn to page 88*)

* Dow Chemical Co.
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Plastics digest

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals mentioned directly to individual publishers

General

PLASTICS AND THE PREFABRICATION OF BUILDINGS. T. Warren Kennedy. Plastics *5*, 211–2 (Nov. 1941). The plastics manufacturer appears to have concentrated almost exclusively on the production of highly glazed sheeting the disadvantages of which are high cost, tendency to warp and the extreme difficulty of fixing the sheets to a structural frame without the use of cover strips. An alternative technique is that of applying the plastic in the form of a paste to existing building blocks. Research along these lines has been conducted by the plastics industry. Synthetic compounds can be applied to the faces of prefabricated blocks to give finishes which are both decorative and weather resisting.

PLASTICS AND POWDER METALLURGY. H. W. Greenwood. Plastics *5*, 215–6 (Nov. 1941). The electrical industries have come to think of plastics in terms of insulators, but by combining plastics with metal powders plastic conductors can be achieved. Parts for quickly dissipating static electrical charges from aircraft could be fabricated from such compositions. Plastics protect the metal particles from corrosion by atmospheric exposure and make it possible to use these mixtures for many decorative applications out-of-doors.

Materials

STYRENE AND ITS INSULATION POSSIBILITIES. T. R. Scott. Elec. Eng. *60*, 478–80 (Oct. 1941). In the development of new insulating materials those which have large scale application in other fields have proven most economical. Styrene, one such material, has decreased steadily in cost. Its plasticization to reduce moisture transference is discussed.

WEATHERPROOFING CELLULOSE ACETATE. E. E. Halls. Plastics *5*, 218–21 (Nov. 1941). Tests involving dry heat at 60 deg. C., water immersion, and high humidity conditions were made on cellulose acetate with and without protective coatings. The latter consisted of a China wood oil varnish and a phenolic resin solution. The phenolic coating which air dries in two hours and is fully hardened after six days prevented the dissolution of plasticizing ingredients and hence acted to preserve the initial flexibility. The varnish showed little improvement over the untreated specimen.

SYNTHETIC ADHESIVES FOR PLYWOOD MANUFACTURE. British Plastics *13*, 186 (Nov. 1941). A foamed urea-formaldehyde resin is said to prevent the swelling caused on thin veneers by the wet glues and to obviate the penetration of the veneer by the resin. The volume of the glue is about doubled by a special beater machine and is spread on the veneers in the form of a foam of about the same consistency as lather produced from shaving soap. It is possible to get a spread of about 1.35 lb. per 100 sq. ft. and hence is very economical. It dries quickly and is pressed at 90-deg. C. The resin bond is reported to be resistant to the three-hour boil test of the English plywood specification B.S.S.5.V.3

Applications

MODERN TRENDS IN FINISHING. E. W. K. Schwarz and Paul Wengraf. Am. Dyestuff Reporter *30*, 610–4, 618–9 (Oct. 27, 1941). An historical survey of the anti-crease process is presented. The effective agents in creaseproofing and methods of measuring this property are reviewed. While ultimately the ideal way of producing an elastic fiber is by purely chemical means, either chemical modification of the cellulosic fiber or producing chemically different fibers such as nylon, there are many possibilities yet to be explored in the application of synthetic resins and other substances to textiles.

VINYON SYNTHETIC FIBERS. Karl Heymann. Am. Dyestuff Reporter *30*, 575, 578 (Oct. 27, 1941). The unique properties of Vinyon offer many interesting and practical possibilities. Vinyon staple fiber has been mixed with wool or cellulosic fibers in the manufacture of felts and yarns. The contraction through heat of the Vinyon staple is utilized in the felting process. Vinyon should find a place in the manufacture of sail cloth, cordage, fish lines and nets, where its resistance to mildew and its high wet strength enable it to outlast many times the currently used materials.

Synthetic Coatings

LUMINESCENT PAINTS. J. M. Fain. A.C.S. News Edition *19*, 1252–4 (Nov. 25, 1941). Resins suitable for the manufacture of luminescent paints include dammar, chlorinated rubber, polyvinyls, po'ystyrene and polymethyl methacrylate. The selection of luminescent pigments and the formulation of these coatings are treated in detail.

MAINTENANCE PAINT FOR THE PULP AND PAPER INDUSTRY. A. R. Olsen. A.C.S. News Edition *19*, 1260–2–4 (Nov. 25, 1941). Chlorinated rubber finishes have the necessary resistance to sodium hypochlorite, sulfite liquor, kraft pulping liquor, soda pulping liquor and saturated chlorine water, to be highly satisfactory for use in paper mills. A sufficient number of coats must be used to ensure ample film thickness and freedom from voids. The film should be dried several days before contact with liquids and should not be used submerged in liquids at temperatures over 140 deg. F. Continuous immersion at lower temperatures gives satisfactory results.

USES AND LIMITATIONS OF RADIANT HEAT FOR BAKING ORGANIC FINISHES. G. Klinkenstein. Metal Finishing *39*, 398–403 (July 1941). A survey of recent advances in the use of infrared rays for curing synthetic resin coatings. A bibliography of important papers contributing to progress in this field is appended.

COATINGS FOR FIBRE AND METAL. C. W. Patton. Modern Packaging *15*, 85–9 (Nov. 1941). The physical properties of commercial plastics used as coatings on packages are tabulated. The methods of application of these coating materials, their fabrication properties when applied to paper or metal, and the typical uses of the various basic coatings are discussed.

Properties and Testing

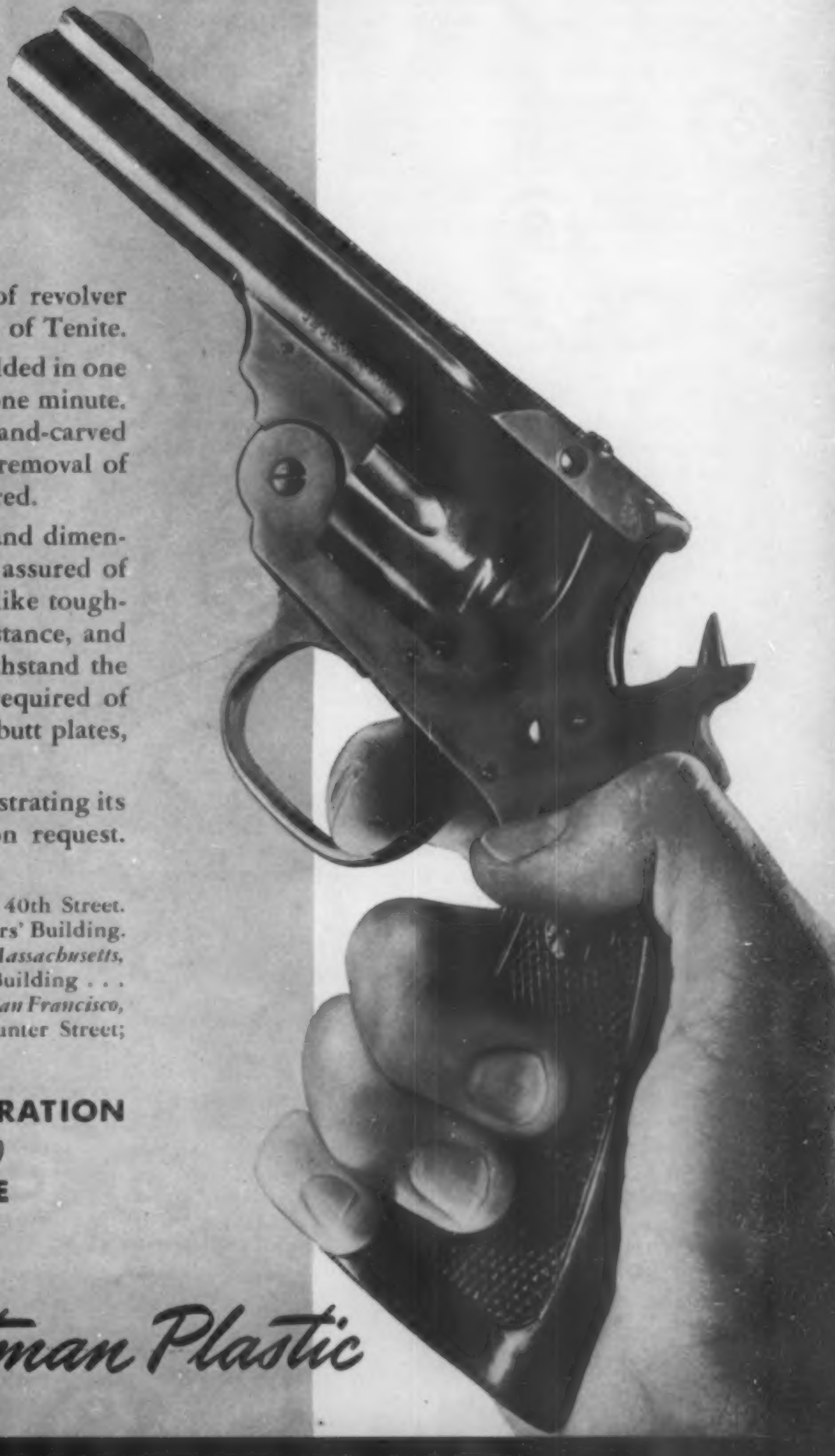
RELATION BETWEEN CHAIN LENGTH DISTRIBUTION CURVE AND TENACITY. H. Mark. Paper Trade J. *113*, 34–40 (July 17, 1941). Experimental methods to fractionate high polymers are reviewed. Preliminary evidence indicates that low molecular constituents are definitely unbeneficial with respect to tenacity.

WATER ABSORPTION OF RESINS. E. P. Irany. Ind. Eng. Chem. *33*, 1551–4 (Dec. 1941). Homogeneous resinous substances absorb water by diffusion in accordance with theoretically deduced law. The latter specifies two independent factors, the rate of penetration or permeability and the saturation limit. In the presence of dispersed granular or fibrous fillers, capillary action predominates. Typical results are presented for polyvinyl acetal, polyvinyl butyral, polyvinyl acetate, polymethyl methacrylate, and cast and laminated phenol-formaldehyde resin.

TE

Pistol grips molded of Tenite by American Insulator Corp. for Harrington & Richardson Arms Co.

Scoring another hit



I*NCREASED SPEED* in the production of revolver handles is now made possible by the use of Tenite.

Two complete handles are injection molded in one operation—an operation that takes only one minute. Since Tenite acquires its polish and hand-carved appearance from the walls of the mold, removal of the gate scrap is the only finishing required.

Because of the exceptional uniformity and dimensional stability of Tenite, each handle is assured of the same even weight and balance. Hornlike toughness, high impact strength, weather resistance, and low heat conductivity enable Tenite to withstand the severe tests of serviceability which are required of such parts as pistol grips, trigger guards, butt plates, gunstocks, fore ends and sight pieces.

Literature on Tenite, describing and illustrating its many properties and uses, will be sent on request.

TENITE REPRESENTATIVES: *New York,* 10 East 40th Street. *Buffalo,* 1508 Rand Building. *Chicago,* 1564 Builders' Building. *Detroit,* 904-5 Stephenson Building. *Leominster, Massachusetts,* 39 Main Street. *Washington, D. C.,* 1125 Earle Building . . . Pacific Coast: Wilson & Geo. Meyer & Company—*San Francisco,* Federal Reserve Building; *Los Angeles,* 2461 Hunter Street; *Seattle,* 1020 4th Avenue, South.

TENNESSEE EASTMAN CORPORATION

(Subsidiary of Eastman Kodak Company)

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TENITE *an Eastman Plastic*

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U.S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

PLASTOMETER. Paul S. Roller. U. S. 2,259,491, Oct. 21. An improved instrument for measuring plasticity in terms of depth to which a loaded plunger penetrates the material.

CATION EXCHANGE RESIN. Hans Wassenegger and Erhard Meier. U. S. 2,259,503, Oct. 21. Insoluble cation exchange resins are made by condensing a phenolsulphonic acid with formaldehyde and partially etherifying the product.

MOLDED POLYMERS. S. S. Kistler (to E. I. du Pont de Nemours and Co.). U. S. 2,259,524, Oct. 21. Polymerizing an unsaturated compound in a silver-lined mold.

CHLORINATED POLYISOBUTYLENE. V. Voorhees (to Standard Oil Co. of Indiana). U. S. 2,259,671, Oct. 21. Polymerizing chloroisobutylene at about −80° F. in presence of a metal halide catalyst.

OLEFIN POLYMERS. C. M. Hull (to Standard Oil Co. of Indiana). U. S. 2,259,695, Oct. 21. Polymerizing an olefin, then successively chlorinating and sulphurizing the polymer.

JOINTING CLAY PIPE. R. H. Manley (to Clay Products Assoc'n.). U. S. 2,259,761, Oct. 21. Compounding a coumarone-indene resin with a plasticizer, a mineral filler and a root-killing agent to make a jointing composition for buried clay pipe.

INJECTION MOLDING. V. S. Shaw and L. S. Hubbert (to Hydraulic Press Corp.). U. S. 2,259,781, Oct. 21. A hydraulic molding press having a pair of pistons and dies, so arranged that the hydraulic fluid cushions one die against the thrust of the other.

CONTAINERS. I. Gurwick (to Shellmar Products Co.). U. S. 2,259,886, Oct. 21. Facing the edges of a transparent regenerated cellulose foil on both sides with lacquer, depositing a thermoplastic over the lacquer on one side, folding the sheet to join the edges and sealing the seams under heat and pressure.

VARNISH. H. J. West and R. E. Layman, Jr. (to American Cyanamid Co.). U. S. 2,259,980, Oct. 21. Dissolving a melamine-formaldehyde resin in a drying oil at a temperature which completes the resinification reaction.

RESINS. G. F. D'Alelio (to General Electric Co.). U. S. 2,260,005–6, Oct. 21. Interpolymerizing allyl crotonate with an unsaturated alkyd resin; and forming a resin by condensing a phenol with an aldehyde and an amide of a dicarboxylic acid.

INSULATED WIRE. R. W. Hall and H. A. Smith (to General Electric Co.). U. S. 2,260,024, Oct. 21. An electric conductor is coated first with spun glass fiber and then with a superpolyamide modified with a synthetic resin.

MOLDING COMPOSITIONS. R. H. Kienle and W. J. Scheiber (to General Electric Co.). U. S. 2,260,033, Oct. 21. A thermosetting molding composition containing a urea-formaldehyde sesin and an alkyd resin.

MOLDING POWDER. A. B. Miller (to Hercules Powder Co.). U. S. 2,260,187, Oct. 21. Compounding a phenol-aldehyde resin with filler, hexamethylenetetramine and extracted pine pitch.

MELAMINE RESIN. W. F. Talbot (to Monsanto Chemical Co.). U. S. 2,260,239, Oct. 21. Condensing melamine with an aldehyde to form a hard, infusible, insoluble resin with high shock resistance.

GASOLINE HOSE. Wm. H. Grint. U. S. 2,260,282, Oct. 28. Making high pressure gasoline hose by repeatedly dipping braided fabric hose in polyvinyl alcohol, adding another layer of braided fabric and facing the assembly with polyvinyl alcohol resin.

PLASTICIZER. T. F. Carruthers and C. M. Blair (to Carbide and Carbon Chemicals Corp.). U. S. 2,260,295, Oct. 28. Plasticizing vinyl resins with dicarboxylate esters of monohydroxy aliphatic acids.

PLASTICIZER. Wm. H. Moss (to Celanese Corp. of America). U. S. 2,260,329, Oct. 28. Plasticizing cellulose ester or ether films with products formed by condensing a dichloroalcohol with toluenesulphonamide or xylenesulphonamide.

NITROCELLULOSE GEL. J. K. H. Seiberlich (to Seiberlich Chemical Corp.). U. S. 2,260,343, Oct. 28. Gelatinizing fibrous nitrocellulose under heat and pressure without solvent or plasticizer.

ELASTICIZER. H. B. Smith (to Eastman Kodak Co.). U. S. 2,260,410, Oct. 28. Compounding an acetal resin made from polyvinyl alcohol and butyraldehyde with tributyl citrate to impart rubber-like elasticity.

HEAT-STABLE COATINGS. G. H. Young (to Stoner-Mudge, Inc.). U. S. 2,260,420, Oct. 28. A resin formed by interpolymerizing vinyl chloride with an acrylate ester is stabilized to heat by adding a heterocyclic base such as isopyrophthalone, stilbazole, quinine, cinchonidine, cinchonicine or pyridylfurylethene.

RUBBER-LIKE POLYMERS. H. Murke (to Jasco, Inc.). U. S. 2,260,475, Oct. 28. Interpolymerizing butadiene with other unsaturates in aqueous emulsion in presence of a tertiary amine.

COLORING RESINS. C. N. Smith (to Carbide and Carbon Chemicals Corp.). U. S. 2,260,543, Oct. 28. Dyeing thermoplastics by immersion in a solution of a dye in a solvent which will penetrate the surface of the plastic without dissolving it.

METHYLOLPHENOL RESINS. H. A. Bruson (to Resinous Products and Chemical Co.). U. S. 2,260,556, Oct. 28. Condensing acylated methylolphenols with a free or esterified natural resin acid.

SLIPPER BEARINGS. Thos. L. Gatke. U. S. 2,260,567, Oct. 28. A slipper bearing for a universal coupling has two molded con-

(Please turn to page 72)

. . . of old materials into plastics requires complete familiarity with the materials and the ability to handle all of them expertly.

Both Tech and Art are right at home in all plastics. Together, they design products (or re-design them) for production in plastics. They make every mold used in our plant, right in our own complete toolshop. They do the molding—both injection and compression—on one of the finest batteries of presses in the country. And they have complete finishing facilities—even to the purchasing of parts in metal and other materials and assembling the completed item ready for sale.

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centric cylindrical segments carrying metal hub inserts, with ring sections fitting into sockets in a molded center block.

HOLLOW ARTICLES. Wm. H. Kopitke (to Plax Corp.). U. S. 2,260,750, Oct. 28. A method and machine for making hollow articles from organic plastics by forming a tube of the plastic and expanding the tube under fluid pressure.

FLAMEPROOF ELECTRIC CORD. H. M. Wilkoff (to American Steel and Wire Co.). U. S. 2,260,761, Oct. 28. Applying flameproof synthetic resin insulation to a wire conductor and covering the insulation with a braided jacket through which the resin projects so that the jacket is also protected from flamel.

SCRATCHPROOF LACQUER. H. G. Donovan (to E. I. du Pont de Nemours and Co.). U. S. 2,260,889, Oct. 28. An alkyd resin modified with hydrogenated castor oil is used in scratch-resisting plasticized nitrocellulose finishes for wood.

UREA RESINS. D. E. Edgar (to E. I. du Pont de Nemours and Co.). U. S. 2,260,890, Oct. 28. Condensing urea with formaldehyde and reacting the product with a monohydric alcohol in presence of a catalyst.

UREA-ALDEHYDE-AMINE RESINS. A. G. Hovey and T. S. Hodgins (to Reichhold Chemicals, Inc.). U. S. 2,261,084–5, Oct. 28. A resin for coatings is made by condensing urea and formaldehyde with a resin formed from a polybasic acid and a monoamine, or by reacting such an amine resin with an alcohol-modified urea resin.

THERMOPLASTIC. F. R. Conklin and C. J. Malm (to Eastman Kodak Co.). U. S. 2,261,140, Nov. 4. Heat-molded articles are made from slightly hydrolyzed cellulose acetate-butyrate or a like mixed ester and a blended phosphate:stearate, phosphate:sebacate or phosphate:phthalate plasticizer.

CELLULOSE ESTERS. Henry Dreyfus. U. S. 2,261,237, Nov. 4. Esterifying chemical wood pulp with a lower aliphatic acid in aqueous sulphuric acid, in presence of the anhydride of the aliphatic acid.

LAMINATED LUMBER. W. Lüty (to Th. Goldschmidt Corp.). U. S. 2,261,264, Nov. 4. Joining thick softwood plies to both faces of an assembly of thin hardwood plies by a thermosetting adhesive.

MOLDED BUTTON. F. G. Purinton (to Patent Button Co.). U. S. 2,261,285, Nov. 4. Plastic buttons are molded with raised metal letters supported by spokes from a metal hub which serves also to receive a fastener for attaching the button.

PROTECTIVE FILMS. K. Thinius and F. Loblein (to Walther H. Duisberg). U. S. 2,261,313, Nov. 4. Wood or leather to be faced with vinyl chloride resin is first coated with an emulsion of vinyl interpolymers, then joined under pressure to the resin sheet.

STABLE RESIN. D. M. Young and W. M. Quattlebaum (to Carbide and Carbon Chemicals Corp.). U. S. 2,261,611, Nov. 4. Clear vinyl resins are heat-stabilized with lead or cadmium compounds.

CHLORINATED HYDROCARBON. R. Waller and C. Gustaffson (to Johan Bjorksten). U. S. 2,261,748, Nov. 4. Chlorinating a volatile oil from cracked petroleum and resinifying the product by polymerization.

ETHYLENE POLYMERS. E. W. Fawcett (to Imperial Chemical Industries Ltd.). U. S. 2,261,757, Nov. 4. Partially dechlorinating the solid or semisolid chlorinated polymers of ethylene.

PETROLEUM RESIN. C. Gustafsson (to Johan Bjorksten). U. S. 2,261,759, Nov. 4. Resinifying cracked petroleum unsaturates by the action of sulphur chlorides or of chlorosulphonic acid.

GOLF BALL COVER. B. J. Habgood (to Imperial Chemical Industries, Ltd.). U. S. 2,261,760, Nov. 4. Using a polyethylene resin as a cover for golf balls.

COATED PAPER. W. R. Collings (to Dow Chemical Co.). U. S. 2,261,964, Nov. 11. Coating printed paper with a cast film of a plasticized cellulose ether and then with a melt of cellulose ether and blended hydrocarbon and ester type waxes.

THERMOPLASTIC FASTENERS. L. H. Morin and D. Marinsky (to Whitehall Patents Corp.). U. S. 2,262,193, Nov. 11. Forming die cast fastener elements by injection molding.

PROTEIN PLASTIC. G. H. Brother and L. L. McKinney (to H. A. Wallace as Secretary of Agriculture of the U. S.). U. S. 2,262,422, Nov. 11. Making a waterproof thermosetting molding composition from soybean casein, glycol and a phenolic resin.

HOLLOW ARTICLES. W. H. Kopitke (to Plax Corp.). U. S. 2,262,612, Nov. 11. Molding plastic articles from an extruded tube of the plastic.

PRESSURE CASTING. Nathan Lester (to Lester Engineering Co.). U. S. 2,262,615, Nov. 11. A pressure casting machine having separable vertical die plates and a vertical casting device with a horizontal discharge nozzle.

ABRASIVE SHAPES. R. S. Daniels (to Union Carbide and Carbon Corp.). U. S. 2,262,668, Nov. 11. Coating abrasive grains first with a tacky oil-modified phenolic resin and then with powdered fusible thermosetting resin, and making shaped articles therefrom by cold molding.

BONDED ABRASIVES. R. C. Swain and D. W. Light (to American Cyanamid Co.). U. S. 2,262,728, Nov. 11. Bonding abrasive shapes with a blend of phenol-aldehyde and amino-triazine-aldehyde resins, cured in contact with the abrasive grains.

BRAKE LININGS. Wm. Nanfeldt (to World Bestos Corp.). U. S. 2,262,733, Nov. 11. Making friction facings from a sulfurized drying oil, a cresol resin, mica, graphite, clay, albumen and pigments.

COATED FILAMENTS. E. W. Rugely, T. A. Feild, Jr., and J. F. Conlon (to Carbide and Carbon Chemicals Corp.). U. S. 2,262,861, Nov. 18. Covering strands, filaments or wires with a wrapping of fibers spun from a vinyl chloride:vinyl acetate interpolymer.

SHEETING. F. R. Conklin and J. S. Kimble (to Eastman Kodak Co.). U. S. 2,262,989, Nov. 18. Continuous production of low shrinking transparent foils by extruding a sheet and transparentizing it by hot rolling.

ACETAL RESINS. C. R. Fordyce (to Eastman Kodak Co.). U. S. 2,262,997, Nov. 18. Precipitating polyvinyl acetal resins from their reaction mixtures by pouring, while stirring, into strong aqueous acetic acid.

SHEETING. P. C. Seel (to Eastman Kodak Co.). U. S. 2,263,015, Nov. 18. Coating a cellulose acetate base sheet with nitrocellulose and then with a vinyl resin to make composite sheeting.

(Please turn to page 72A)

PICTURE FRAMES. J. A. Gits (to Gits Molding Corp..) U. S. 2,263,037, Nov. 18. A die construction, with two or more die blocks bounding a rectangular molding chamber.

BLENDED RESIN. W. D. Johnston, Jr. (to Neville Co.). U. S. 2,263,213, Nov. 18. Blending a coumarone resin with 2 percent or more of Formvar (acetal resin) and sufficient Nevillac (phenol-modified coumarone resin) to promote homogeneity and prevent embrittlement.

BY-PRODUCT RESIN. J. Rivkin and L. M. Geiger (to Neville Co.). U. S. 2,263,224, Nov. 18. Resins from still residues remaining after fractionating coke oven light oils are purified by neutralizing the alkaline ash with rosin, the resulting resinate being recovered.

LIGHT POLARIZER. H. G. Rogers (to Polaroid Corp.). U. S. 2,263,249, Nov. 18. Cementing a light polarizing layer of vinyl resin containing oriented polyvinylene particles to a glass sheet with a polyvinyl alcohol adhesive.

NITROUREA RESINS. G. F. D'Alelio and J. B. Holmes; G. F. D'Alelio (to General Electric Co.). U. S. 2,263,289–90, Nov. 18. Condensing urea and an aldehyde, or phenol and an aldehyde, with not more than $^1/_4$ mol of nitrourea.

CHLOROPRENE POLYMER DISPERSIONS. H. W. Walker and F. N. Wilder (to E. I. du Pont de Nemours and Co.). U. S. 2,263,322, Nov. 18. Use of a water-soluble betaine derivative both as stabilizer and as emulsifier in stable aqueous dispersions of chloroprene polymers.

CURING RESINS. N. A. Shepard (to American Cyanamid Co.). U. S. 2,263,447, Nov. 18. Use of benzoyl- or phthaloylmercaptobenzothiazoles as latent catalysts for acid-curing thermosetting resins.

INTERPOLYMER. W. Starck and K. Billig (to General Aniline and Film Corp.). U. S. 2,263,598, Nov. 25. Making a clear colorless resin by polymerizing 50 parts of vinyl acetate with 15 parts of crotonic acid in presence of acetaldehyde and benzoyl peroxide.

OLEFIN HALIDE RESINS. W. J. Sparks and D. C. Field (to Standard Oil Development Co.). U. S. 2,263,654, Nov. 25. Polymerizing propylene (or higher alkylene) halides at temperatures below 0 deg. C. in presence of a volatile Friedel-Crafts type catalyst.

WOOD PANEL. Wm. Walker (to Celanese Corp. of America). U. S. 2,263,661, Nov. 25. Non-warping laminated wood panels are made with thin paper and a urea resin adhesive between plies, and are faced with cellulose acetate foil appiled with a nitrocellulose cement.

BUTTONS. R. O. Wood (to Button Corp. of America). U. S. 2,263,792, Nov. 25. Forming molded articles with a thermo setting resin core and a thermoplastic face.

WINDOW SHADE. E. H. Nollau (to E. I. du Pont de Nemours and Co.). U. S. 2,263,900, Nov. 25. Window shades which look like ground glass when viewed by transmitted light are made from a synthetic fiber with its interstices filled with a pigmented film and coated with a more heavily pigmented film.

ROSIN POLYMERS. J. N. Borglin (to Hercules Powder Co.). U. S. 2,263,915, Nov. 25. Low temperature polymerization of rosin or its esters in presence of a metal chloride.

FASTENERS. E. H. Dau (to Talon, Inc.). U. S. 2,263,920, Nov. 25. Molding individual fastener elements attached to a stringer tape at spaced intervals.

REFLECTOR BUTTON. T. H. Morcom (to General Railway Signal Co.). U. S. 2,263,953, Nov. 25. Molding reflector buttons from a transparent thermoplastic, with a refracting face and a spherical segment of reflecting material.

METAL INSERTS. Werner Osenberg. U. S. 2,264,003, Nov. 25. Spraying a molten metal into a portion of smooth surface mold, and forming a resin article in the mold so that the sprayed metal is bonded to and retained by the molding.

ALDEHYDE RESINS. C. C. Allen (to Shell Development Co.). U. S. 2,264,034, Nov. 25. Forming resinous plastics by condensation of isobutenal or its next higher homologs with a ketone or with a different aldehyde in presence of an autopolymerization inhibitor and an alkaline condensation catalyst.

AMIDINE RESIN. K. Keller (to I. G. Farb. Akt.). U. S. 2,264,137, Nov. 25. Making resins by condensing 1 mol of a polycarboxylic acid with 0.75 to 2 mols of a polymerizable polyhydroxymethylene derivative of a cyclic amidine.

WINDOW SHADE. W. W. Mulberg (one-half to Rudolph Axel). U. S. 2,264,140, Nov. 25. A transparent roller shade for screening out ultraviolet rays from sunlight is made of nonflammable scuff-resisting nitrocellulose, vinyl resin or cellulose acetate sheeting dyed with methyl orange.

CHLOROPRENE POLYMER DISPERSION. A. M. Collins (to E. I. du Pont de Nemours and Co.). U. S. 2,264,173, Nov. 25. Emulsion polymerization of chloroprene in presence of sulphur.

FELTED FIBER PRODUCT. W. W. Richter and H. R. Gillette (to Federal Electric Co., Inc.). U. S. 2,264,189, Nov. 25. A hard, stiff composition of fiber and a resin obtained as a residue from refining solvent-extracted rosin.

NONGLARE UNITS. J. H. Sherts (to Pittsburgh Plate Glass Co.). U. S. 2,264,190, Nov. 25. In laminated nonglare units two perforated layers of polarizing material are joined, and faced on both sides, by resin layers which are themselves bonded to the outer layers of the laminated product.

CHLOROPRENE POLYMER DISPERSIONS. H. W. Starkweather and F. N. Wilder (to E. I. du Pont de Nemours and Co.). U. S. 2,264,191, Nov. 25. Emulsion polymerization of chloroprene in presence of sulphur, a water-soluble alcohol and a water-soluble ketone.

LAMINATED COLLARS. T. H. Swan (to Cluett, Peabody and Co., Inc.). U. S. 2,264,224, Nov. 25. Collars and cuffs are made by facing fabric with a vinyl chloride:vinyl acetate (80:20) interpolymer, plasticized with tricresyl phosphate and pigmented with titanium dioxide, cutting blanks therefrom and inserting the blanks as interlayers in the finished collars or cuffs.

LIGHT-FAST RESIN. R. F. Boyer, L. A. Matheson and C. L. Moyle (to Dow Chemical Co.). U. S. 2,264,291, Dec. 2. Stabilizing a vinylidene chloride resin to light by adding a dihydroxybenzophenone.

POLYAMIDE RESIN. M. M. Brubaker (to E. I. du Pont de Nemours and Co.). U. S. 2,264,293, Dec. 2. Heating a polyamide-forming composition in presence of 0.1 to 5 mol-percent of ethanolamine or propanolamine to form products with stabilized viscosity and improved dyeing behavior.

METHACRYLATE RESIN. J. R. Hiltner and W. F. Bartoe (to Röhm and Haas Co.). U. S. 2,264,376, Dec. 2. Forming a resin which is free from elastic memory by emulsion polymerization of methyl (or ethyl) methacrylate under pressure.

Publications

Write direct to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

1941 Supplement to A.S.T.M. Standards

Published in 3 parts by the American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa.

Price: $7.00 complete, 2 vols. $5.00, 1 vol. $3.00

The new supplements to the 1939 Book of A.S.T.M. Standards bring up-to-date information regarding the methods of testing which have been developed by the various Committees and approved by the Society. These supplements relate, respectively, to the same materials covered in the triennial Book of Standards, namely: Part I, Metals; Part II, Nonmetallic Materials, Constructional; Part III, Nonmetallic Materials, General. The latter volume contains eleven new or revised tentative methods for testing plastics. An Index to A.S.T.M. Standards and Tentative Standards which lists all of the methods appearing in the 1939 Book of A.S.T.M. Standards and the 1940 and 1941 Supplements is published separately. This booklet is furnished without additional charge to purchasers of any or all volumes of the 1941 Supplements. G. M. K.

Rubber and Its Use

by Harry L. Fisher

Chemical Publishing Co., Inc., 236 King St., Brooklyn, 1941

Price $2.25.

The story of rubber—where it comes from, how it is obtained and the processes by which it is converted into countless articles of daily use—is told briefly and interestingly. Recent developments in synthetic rubbers and rubber derivatives are also described. The author and publisher have provided in this book a praiseworthy introduction to a fascinating subject. G. M. K.

★ CATALIN CORP., 1 PARK AVE., NEW YORK CITY, HAS issued a new booklet giving details on how their material may be used. It constitutes a handy outline of methods and equipment for Catalin. There is an interesting section on drilling, threading and tapping with five graphic illustrations of the progressive processes. New casting techniques are also fully discussed.

★ IN CONNECTION WITH THE 1939 CENSUS OF BUSINESS, a 150-page report on employment and pay roll of wholesale establishments has been published by the Census Bureau, U. S. Department of Commerce, as part of the 16th Census of the United States. It presents monthly employment in wholesale trade, by kinds of business, and employment and pay roll for one week of 1939 by occupational groups. The facts were obtained in 1940 by a complete field canvass throughout the United States, conducted under the supervision of the regular field organization of the Bureau of Census.

★ WRITTEN TO AID THE AVIATION INDUSTRY, A 16-page booklet, "Solutions to Your Transparent Enclosure Problems with 'Lucite,'" has been issued by the Plastics Dept., E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.

★ BRISTOL CO., WATERBURY, CONN., HAS A POCKET sized folder of 10 pages describing its line of Hex Socket Screws which include set screws, socket head cap screws, socket head stripper bolts, pipe plugs, key and screw driver type keys.

★ PLASTICS DIVISION OF CARBIDE AND CARBON Chemicals Corp., 30 East 42nd St., N. Y. C., has issued a 30-page booklet, "Vinylite Plastic Sheet and Sheeting," containing complete data and information on the various sheet forms produced by the company from the copolymer groups of vinyl resins.

★ "FACTS ON U. S. GOVERNMENT FINISHES," A CONvenient file folder, has been published by Roxalin Flexible Lacquer Co., Elizabeth, N. J. It contains data sheets on the widely used Army and Navy specification finishes and tells how and where they are applied.

★ R. D. WERNER CO., INC., 380 SECOND AVE., NEW York City, has issued an 8-page brochure covering its line of extruded moldings for trim, nosings, edgings, coves, cap sections, etc. Diagrams, cross sections and four-color illustrations show how the material may be installed and handled.

★ OF TIMELY IMPORTANCE, TWO BULLETINS REcently issued by Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J., point out the problems involving supplies of dyestuffs and coloring materials under the present program. Bulletins are titled "Priorities and the Dyestuff Industry" and "Blackout Preparations in the United States."

★ RÖHM AND HAAS CO., 222 WEST WASHINGTON Square, Philadelphia, has issued the "Plexiglas Fabricating Manual," a 48-page illustrated technical booklet which describes in detail the methods adopted in its own fabricating plants and suggests some alternate methods. The book gives the accepted tolerances on many operations and explains many of the limitations in fabricating the material. Wherever practical specific definite saw speeds are recommended, buffing compounds suggested and fabrication related to some conventional material to enable experienced workmen to relate their experience to handling the plastic.

★ A NEW LIST OF PLASTICS CONSULTANTS WILL be supplied by The Association of Consulting Chemists and Chemical Engineers, Inc., 50 East 41st St., New York City. This, they believe, should be a great aid to the small manufacturer faced with the problem of priorities and the necessity of nevertheless producing his product for civilian needs.

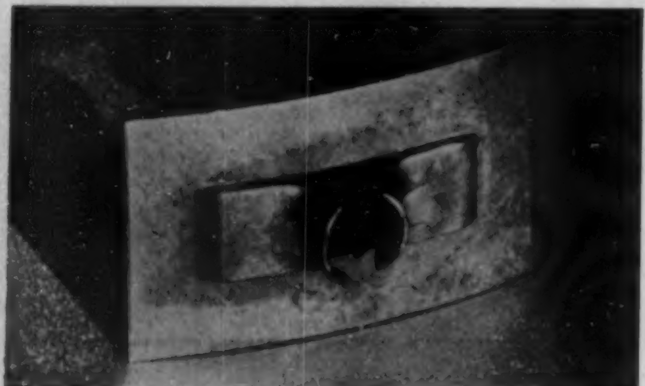
★ A HANDSOME BROCHURE PRINTED IN RED, WHITE and blue and well illustrated with photographs has been issued under the title of "The Baldwin Group in National Defense." It describes the defense production of hydraulic presses, testing machines, firearms, tanks, shells, steel and power plant equipment, by workers in the following factories that constitute the Baldwin Group which has headquarters in Philadelphia: The Baldwin Locomotive Works, Baldwin De La Vergne Sales Corp., Baldwin Southwark, Cramp Brass and Iron Foundries, The Midvale Co., The Pelton Water Wheel Co., Standard Steel Works and The Whitcomb Locomotive Company.

★ AN INTERESTING 8-PAGE FOLDER RECENTLY REleased by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., is titled "The New Resin-Bonded Plywood." It contains a brief history of the plywood industry, describes present-day methods of manufacture and illustrates the widespread uses of this new structural material, including a discussion of its application in aircraft. Such phenolic-bonded plywood, although now being purchased in huge quantities by the Government for mosquito boats, barracks and similar purposes, may well become the backbone of the prefabricated house industry when this emergency has passed. As already planned, built and under test, these houses will sell in the two-three thousand dollar bracket, completely equipped.

Machinery and Equipment

★ WALKER-TURNER CO., INC., HAS INTRODUCED A 20-in. drill press for power feed, hand feed or foot feed applications, in drilling and reaming. Power feed unit has a built-in clutch which is part of the worm drive. The unit is powered from the drill press spindle at various rates of speed. The machine is available with single spindle (above) or 4-spindle models.

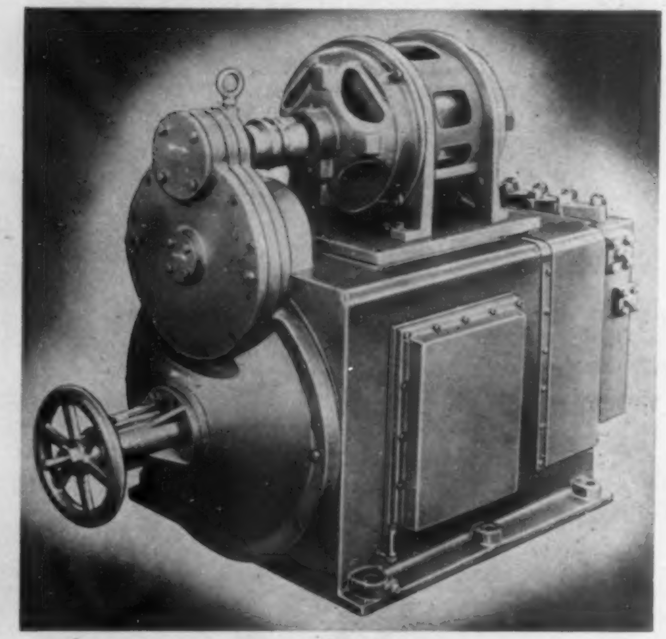
★ AN IMPROVED ENGRAVING MACHINE OF PANTOGRAPHIC operation for rotary engraving, electrical marking and acid etching was recently put on the market by H. P. Preis Engraving Machine Co. Separate heads, quickly interchangeable, are used for the three classes of work. The basic machine is a compact unit, 21 in. long, 14 in. wide and 15 in. high.



★ CALLED "QUICKIES," A NEW METHOD IN SPRING nut fastenings for plastics (pictured above) developed by the Prestole Devices Div., Detroit Harvester Co., is now on the market. These fastenings, it is reported, were designed to compensate for the expansion and contraction of plastic materials when subjected to varying temperature conditions. They are claimed to be particularly adaptable for use in airplanes where plastics are used for trim, or structural purposes. These fasteners are being produced for use with 1/4-in., 5/16-in. and 3/8-in. studs.

★ IN ORDER TO MEET THE HEAVY DEMANDS OF defense orders, the Detroit Surfacing Machine Co. offers an improved model of its Easy Electric Sander which, it claims, can well stand up under the two and three day shifts. Vibrations have been reduced through precision balancing and redesign of handle mountings. A new interchangeable front handle can be shifted from front to side position enabling the operator to work into close quarters, at right angles and directly against vertical surfaces. An improved type fan and baffle plate increase the flow of air through the motor to insure adequate cooling. The sander is suggested for many finishing applications—sanding, rubbing, polishing for metal, plastics, wood and leather.

★ ERNST MAGIC CARRIER SALES CO., HAS ADDED A new 600-lb. capacity carrier to its line. This model was designed and constructed for handling litherage drums which are principally used as containers of heavy materials.



★ THIS NEW VARIABLE DELIVERY STEDIFLO HIGH pressure pump (above) which is claimed to permit stepless change from 0 to 6 g. p. m. at 5000 lbs. per sq. in. pressure has been built by Watson-Stillman Co. The flow is accomplished by a new driving member trunnioned on the drive shaft. Its angle can be varied while the pump is running to produce a corresponding stepless change in plunger stroke from zero to full 4-in. stroke. The stroke control shaft is extended to the outside of the pump casing for attachment to a manual or automatic pressure control. Pump is suggested by the manufacturer for hydraulic press applications where a rapid advance must be followed by a slow movement at high pressure and for boiler feed where sudden changes in output affecting the water level are met.

★ BLACK DRILL CO., HAS DEVELOPED A NEW TYPE OF drill which it claims will cut hardened steel of any type, temper or analysis. The tool is known as a "hardsteel" drill and has been used, thus far, on carburized, oil hardened, water hardened, cyanided and nitrided pieces of high carbon, high chrome and high speed drills of every degree of hardness. The drills are designed to drill, ream, countersink and counterbore.

In the plastics picture

★ MICHIGAN MOLDED PLASTICS, INC., DEXTER, Mich., announces that the following representatives are in charge of its district offices throughout the country: James T. Libbey, 6432 Cass Ave., Detroit, Mich.; W. E. Campbell, Box 1041, Dayton, Ohio; N. G. Bickford, 662 Monroe Ave., Rochester, N. Y.; William L. Thomas, Box 2622, Lakewood, Ohio; L. R. Christiansen, 225 Fifth Ave. Building, Moline, Ill.; and Proctor L. Dougherty, National Press Bldg., Washington, D. C.

★ J. W. McNAIRY, ASSOCIATED WITH GENERAL Electric Co. for 24 years, has been appointed assistant manager of the Bridgeport Works of the General Electric Co., it was announced by W. Stewart Clark, works manager.

★ AS AN AID TO INDUSTRY IN THE DEVELOPMENT OF new processes and materials, Farrel-Birmingham Co., Inc., Ansonia, Conn., has expanded the testing facilities at its Derby, Conn., plant by completely re-equipping the laboratory it has operated there for some years.

★ A NEWLY IMPROVED PAINT, DESIGNED FOR USE in plants and offices where odors from conventional paints are offensive to workers, has been announced by American-Marietta Co., 43 E. Ohio St., Chicago. The paint is actually de-odorized before canning, and not perfumed, according to the report.

★ DR. MARTIN H. ITTNER HAS BEEN ELECTED TO receive the Perkin Medal of the Society of Chemical Industry for 1942. The medal is awarded annually for outstanding work in applied chemistry, and the medallist is selected by a committee representing the five chemical societies in the United States. It was presented on January 9, 1942, at a meeting held at The Chemists' Club, 52 East 41st St., New York City.

For almost 45 years Dr. Ittner has been in charge of research at Colgate-Palmolive-Peet Company or predecessor companies. Among Dr. Ittner's many contributions is his development of a successful commercial process for the hydrogenation of fatty oils, on which process he has been granted a number of patents. He has also made valuable contributions in the field of distillation and he holds several recent patents pertaining to new processes for glycerin production.

★ ARROW PLASTICS CORP. ANNOUNCES ITS REMOVAL from 131 West 28th St., N. Y., to 178 River Drive, Passaic, N. J.

★ PLASTICS CONSULTANT CORP. HAS MOVED TO new and larger headquarters at 121 East 24th St., New York City.

★ A NEW AND LIGHTER SHADE OF "MACHINE TOOL gray" has been endorsed by the National Machine Tool Builders' Association as the standard finish for machine tools. The date of adoption of the new color standard is optional. This will permit each machine tool builder to time the change from the old to the new standard as best fits his circumstances and his customers' requirements.

★ PLASTIC-WARE, INC., HAS MOVED TO NEW OFFICES at 238–240 William St., New York City.

★ THE FACILITIES OF ITS TESTING AND RESEARCH laboratories are now available to manufacturers in any field, according to an announcement from the Plastics Industries Technical Institute, 186 South Alvarado St., Los Angeles. The school has just installed a Peakes-Rossi flow tester and a Universal Testing Machine to round out its present equipment. Injection and compression presses are also available at the Institute to examine and check molding properties, it is reported.

★ THREE REPRESENTATIVES OF AMPCO METAL CO., Inc., can now be reached at their new addresses. F. A. Burnett, formerly with the Cincinnati office, is now in Indianapolis, whence E. A. Svoboda has departed to take charge of the company's Cleveland branch; and Russell E. Campbell has joined the West Coast division.

★ MANUFACTURERS CHEMICAL CORP., PRODUCER of Macite molding material, has moved its plant from Jersey City to Berkeley Heights, N. J.

★ THEME OF THE 53RD WESTERN HOME FURNISHings Market at San Francisco, Jan. 26 to 31, inclusive, is "Today's Job" in national defense and business preparedness.

★ THE 1942 PACKAGING EXPOSITION AND CONFERence will be held at the Hotel Astor, New York City, from April 14 to 17, inclusive, according to an announcement by the American Management Association, sponsor.

★MULTI-PLASTICS CORP., LOS ANGELES, CALIF., announces that C. K. Castaing is now associated with them as chief designer and consultant in plastics.

★ WELLER CHEMICAL CO., 141 MILK ST., BOSTON, Mass., are selling Piccolyte resins and Piccoumaron resins to the rubber trade in New England. They are manufactured by the Pennsylvania Industrial Chemical Corp., Clairton, Pa.

★ CHARLES F. KETTERING, VICE-PRESIDENT AND director of Research, General Motors Corp., was the principal speaker at the dinner and meeting of the Detroit Rubber and Plastics Group, held at the Hotel Detroit Leland, Friday, December 12, 1941.

★ GARTEX XR, A FINELY DIVIDED, SPECIALLY treated and highly uniform silica, is one of several grades being developed by an industrial fellowship at Mellon Institute of Industrial Research, Pittsburgh, by Garco Products, Inc., Butler, Pa. It is a mineral filler which has been thoroughly processed. The methods of manufacture are said to produce material extremely uniform in particle-size and chemical characteristics. Suggested for a wide range of plastic materials, the filler is said to have good surface properties, acid resistance and mold properties, which help improve hardness and impact resistance of certain moldings.

★ FORMATION OF AMERICAN MOLDING POWDER & Chemical Corp. was announced by A. Bamberger, president. The company, which is located at 109 South 5th St., Brooklyn, New York, manufactures cellulose acetate molding powder and handles scrap materials.

★ THE FIRST 1942 MEETING OF THE QUEBEC RUBBER & Plastics Group was held January 9th. Principal speaker was W. M. Davidson, general manager of Bakelite Corp. of Canada.

★ NEW JERSEY ENGRAVING CO., MOLDER AND mold maker, has moved its plant to 1140 Commerce Ave. at Vaux Hall Road, Union, New Jersey. Tel.: UNionville, 2-5000.

★ PLASTICS MACHINERY, RAW MATERIALS AND APplications played a prominent part at the recent 18th Exposition of the Chemicals Industries in Grand Central Palace, New York, December 1–6. Contributions to the nation's economy, production potentialities and new materials for many uses were evident in the exhibits sponsored by plastics manufacturers and allied industries. New equipment for producing chemicals and plastics was of interest. *(Please turn to next page)*

Government and industry

★ AN INVENTORY AND REQUISITIONING SECTION was set up December 9, 1941, in the Office of Production Management under the Priorities Division, to provide for prompt acquisition of war materials whenever normal sources are inadequate.

The new section will administer the power to requisition materials and supplies as provided in the Executive Order of the President issued November 19, 1941, providing for the administration of the requisitioning of property required for national defense. E. A. Tupper will act as chief of the section, under the general supervision of L. J. Martin, chief of the Compliance and Field Service Branch. The requisitioning procedure will not be used to interfere with control over the flow of materials to war and essential civilian industries by the priorities system, but will supplement the priority system whenever priority orders are insufficient to get essential materials to the right place at the right time. To facilitate the work of the new section, the survey of existing inventories of scarce materials which has been undertaken by the Industrial Branches of OPM will be speeded up, and inventory control will be tightened all along the line.

★ THE FIRST TWO OF A SERIES OF 16-MM. SOUND motion picture films based on the book "How to Run a Lathe" have just been released by the South Bend Lathe Works, South Bend, Indiana. Professionally filmed in full color, these pictures represent the most advanced technique for teaching lathe operation in industrial and vocational schools, universities, Army and Navy training stations. The first film titled "The Metal Working Lathe," introduces the apprentice to the standard back-geared screw cutting lathe by familiarizing him with the names of the various lathe parts, their purpose and operation. It is ideally suited for showing to beginners before they operate a lathe for the first time. After seeing the film, the student may be allowed to manipulate the various lathe controls, as demonstrated in the picture. The second film, "Plain Turning," clearly illustrates all operations in the machining of a shaft held between the lathe centers.

★ THE BALDWIN LOCOMOTIVE WORKS AT EDDYstone, Pa., which produces weapons for national defense, also turns out the men behind the men behind the guns. Anticipating a shortage of skilled workers in defense industries, the company opened its school shop in the fall of 1940 and, operating 24 hours a day with 3 shifts of trainees, has already graduated over 1000 capable machine tool operators. To be admitted to the Baldwin school, a man must be at least 18 years of age, an American citizen, not less than 5 ft., 7 in. tall and weigh over 140 lbs.—the latter requirements necessitated by the size of the machines to be used. The training course is free, and graduates go to work immediately in the Baldwin plant.

★ FOUR NEW FIELD OFFICES OF THE PRIORITIES Division of the OPM have opened for business, according to an announcement by Donald M. Nelson, Director of Priorities. With the addition of these new offices, the Priorities field service offers to businessmen the assistance of 38 district managers and their staffs, in problems arising in the application of Priorities.

★ WITH THE OUTBREAK OF WAR, IT BECAME IMperative, the Priorities Division, OPM reported, to conserve scarce alloying elements used in the production of alloy iron and steel. To effectuate this, an amendment to General Preference Order M-21-a was issued, effective December 20, 1941, prohibiting producers from melting any alloy iron or alloy steel containing specified alloying elements in specified amounts, except to fill orders with rating of A-10 or higher, or by special direction of the Director of Priorities.

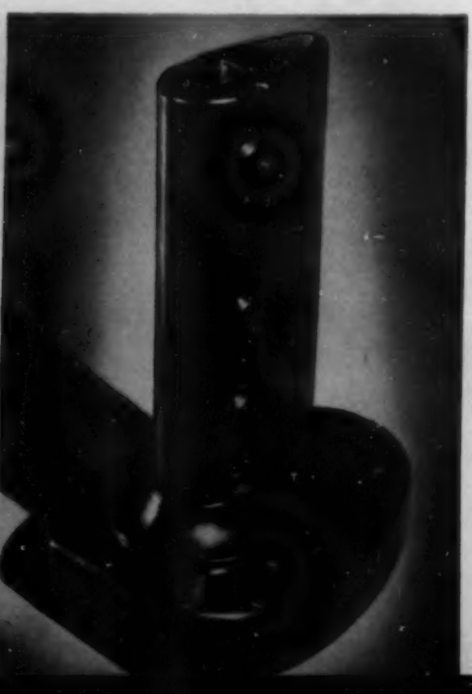
Effective January 1, is a prohibition of delivery of such materials save on the same terms, with an added proviso that the Director of Priorities may issue orders directing or forbidding specific deliveries. Under the terms of the amendment, the Priorities Director may also issue orders governing the amount of any alloying material to be used in the production of any alloy steel or alloy iron.

Increased demands for alloy steels are responsible also for the complete allocation system for vanadium under General Preference Order M-23-a which provided for monthly requests for vanadium allotments and authorizes the Director of Priorities to make monthly allocations without regard to previous preference ratings. (Consumers receiving less than 50 lbs. per month need not file reports.) Ninety-nine percent of the U. S. vanadium supply is used in the manufacture of high speed steel for special castings, machine tools, etc. Approximately half of our supply is produced domestically and the remainder comes from Peru.

Sorry!

★ ON PAGE 41 OF THE DECEMBER 1941 ISSUE WE omitted the name of the manufacturer of the plastic topped compacts and cigaret cases. They are made by Evans Case Co., Attleboro, Mass.

★ IN THE ARTICLE, "FROM NINE TO FIVE" WHICH appeared in our October 1941 issue, the two adding machines shown in Figs. 5 and 6 were incorrectly identified. Both were designed by Willis Ahlborn Kropp of River Forest, Ill. The first is the standard adder model used in the Victor adding machine line. The latter is being used by Sears Roebuck and was designed to incorporate key openings in the molded housing. All of the contours are dimensioned and there are practically no straight surfaces—improving appearance and tending to eliminate mold marks. Both models were molded by General Electric Co.'s Plastics Department.



★ IN THE INTERESTS OF ACCURACY WE present two views of the Bell polystyrene stanchion which won an award in the 1941 Modern Plastics Competition. In describing this stanchion on page 134 of the November issue, we made a highly regrettable error in illustrating the wrong model. The stanchion (at left) was injection molded of polystyrene by Erie Resistor Corp. for Bell Aircraft Corp. and is used on the Bell Airacobras sent to the R.A.F. This large injection molded piece is about 8 in. high, with a base $3^1/_2$ in. by 5 in., has excellent electrical insulating properties, is strong and lightweight. As pictured at the right of page 134, November 1941, a metal streamlined mast is fastened over the stanchion to which the antenna is attached and the complete assembly set at the rear of the pilot's cockpit.

Plastics in British aircraft

This review of developments in the use of plastics in the British aircraft industry by our London correspondent (see page 102), closely parallels similar activity in the United States.—ED.

THE demands of the vast British aircraft industry are now so diverse and extensive that there is no plastic material manufactured which does not find some use in aircraft production, from the clear acrylics used for the power operated turret and hood to the polyvinyl resin extrusions for covering cables and the synthetic rubber engine mountings. Plastics have been chosen because they can do the particular job better than any other material, or because they release for more vital work a limited and badly needed supply of some particular light metal.

Prior to the outbreak of hostilities, the British aircraft designer was justly accused of ignoring plastics except for applications where no other material would answer the purpose. There was a certain amount of justification for this accusation. Designers as a whole were not too well conversant with the properties of the new materials or they were unwilling to adapt them for other than non-stressed and very lightly stressed parts. There was at that time no lack of light metals and therefore production presented fewer difficulties than it does today.

Today the Ministry of Aircraft Production is by far the largest customer of the British plastics industry, and the present prosperity enjoyed is due mainly to the constant flow of orders from this vital Government department. Practically 90 percent of the acetate produced in Great Britain is now used for aircraft components, and a correspondingly high percentage of the acrylic resins. It is the thermoplastics which so far have contributed the lion's share to aircraft production in Great Britain and, indeed, research seems to favor their more extensive use. Developments in the evolution of stronger transparent plastics are now producing promising results and are likely to become more important in the near future. The use of mixed esters, special reinforcements and new plasticizers are responsible for stepping up the physical properties of these plastics.

The new cellulose laminated thermoplastic material Pytram, shown for the first time on July 23, 1941, at a private exhibition in London organized by the Society of British Aircraft Construction, has been specially developed for aeronautical purposes. This is the outstanding example of the aircraft industry's calling the tune for the plastic manufacturer to dance to. In the case of Pytram, the fiber orientation is so arranged that the material is less likely to suffer accidental denting and other impact damage than metal or even competitive thermoplastics. On a strength to weight basis, Pytram compares extremely favorably with similar types of plastics. The density is 48 lbs. per cu. ft.; specific gravity 0.77; tensile strength 3900 lbs. per sq. in.; shear 2000 to 3000 lbs. per sq. in.; bending test (modulus of rupture) 5960 lbs. per sq. in. The damping properties are claimed to be high and, therefore, fairings of this material are less likely to flutter than those of metal. According to the first published account of the material by Dr. Yarsley (*Times* Trade & Engineering Report, August 1941) Pytram is a cellulose fiber material bonded with special type adhesives on the laminated principle. The natural inherent resilience resists indentation and the very nature of the material suggests that, in fatigue under vibration, it has qualities superior to other materials commonly used. The initial difficulty of the effects of weather on this synthetic material has now been overcome. The material has many of the characteristics of metal and light alloys, is light in weight, strong and resilient. The original strength and fiber orientation of the material are retained and, as compared with metal of a similar weight, it is much less likely to suffer damage. Shapes of all types, with complicated double curvatures, can be easily and cheaply produced in large or small quantities. The latter point is of very great importance, as with some of the transparent plastics it has hitherto been found that the stresses and strains set up by forming these double curvatures sometimes cause trouble during service under difficult conditions.

It might be as well to mention that one of the factors now taken into increasing consideration is the effect of extreme cold on thermoplastics. Now that the tendency seems to be more and more toward sub-stratosphere flights, it is necessary to ensure that there will be no undesirable physical changes in the molecular structure of the transparent plastic components. Increase in brittleness naturally means an increase in the fragility of the machine and a greater risk of its becoming a casualty. This difficulty is overcome to a large degree by improved plasticizing.

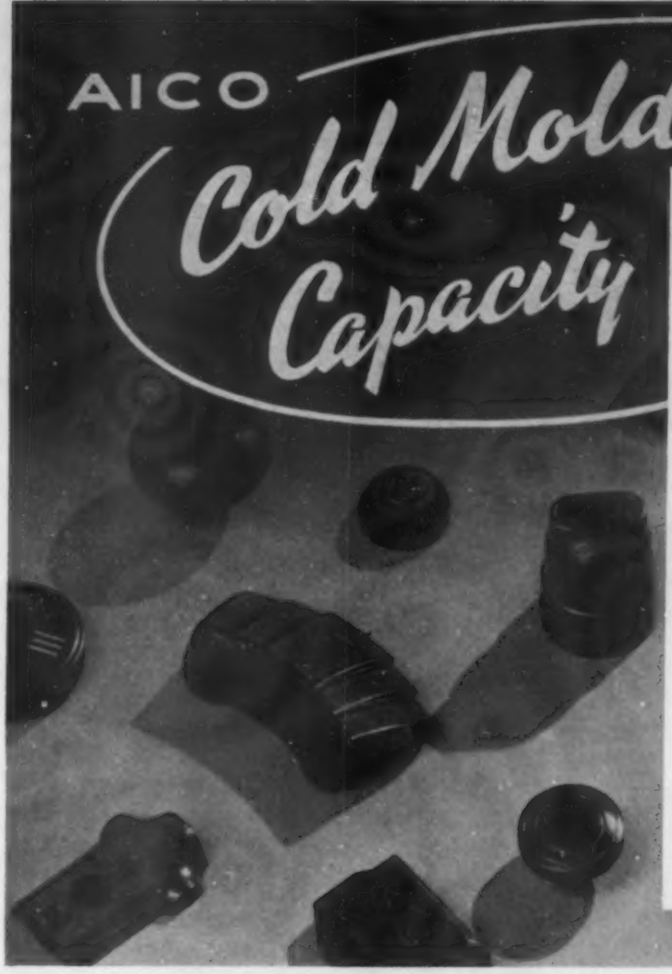
The British thermoplastic insulating material Isoflex, which resembles layered corrugated cardboard in appearance and texture, is made up from thin corrugated sheets of cellulose acetate held together by flat sheets of the same material. One cubic foot of the material weighs only $^3/_4$ lb., or, roughly, $^1/_{10}$ the weight of cork slab. The thermal conductivity of Isoflex is 0.32 B. T. units compared with 0.38 for wood fiber board and 0.25 for slab cork. There is every reason to expect that this extremely lightweight material will find important applications in aircraft for insulating purposes.

Before leaving thermoplastics it is necessary to mention vinyl resins. At the outbreak of war, Great Britain was in a very unhappy position regarding these materials, as none were produced at home. Today, however, the position is somewhat easier as polyvinyl chloride is being manufactured by the I.C.I. and supplies are available for pressing needs, such as extrusions for cable and wire covering. There is a growing need for vinyl resins in the aircraft industry and home manufacture cannot supply all requirements.

Since 1939, increasing quantities of all types of plastic glues and cements have been utilized by the aircraft industry, and it is realized that these materials are of the greatest importance for a wide variety of uses. Literally hundreds of specialized adhesives are in daily use by manufacturers for sticking every imaginable material, from textiles to metals. In the manufacture of aeronautical plywood, resin is now regarded as a considerable improvement over casein and other natural protein glues, as it imparts superior physical properties to the plywood and endows it with increased resistance to moisture. The so-called "improved" wood made up of veneers of birch and other wood impregnated with phenolic resin and pressed together under heat and pressure has found many new applications, both in the actual construction of aircraft and in the many new industries feeding the Ministry of Aircraft Production plants. This material is especially valuable where excellent physical properties and high dielectric strength, as well as immunity to chemicals and moisture, are needed. Not only are the thermosetting cements and glues being used to a very large extent, but the thermoplastic cements also are finding increasing applications where a resilient and high shock or vibration resisting film is required. There is no doubt that in the field of adhesives the plastics industry has made one of its most important contributions and one which will most certainly receive a full bonus after the war.

Although no actual details can be given for reasons of security, it can be said that phenol-formaldehyde moldings and pieces fabricated from phenolic laminated materials are being used for many different types of components, some of which have to withstand strains and stresses considered impossible before the war, while others are for non-stressed fittings and electrical accessories. The latter are being produced in increasing numbers, owing to the growing importance of radio location. A resin which has found its real opportunity is aniline-formaldehyde resin, both in the laminated and unfilled form. This particular plastic possesses excellent physical and (*Please turn to page 100*)

AICO *Cold Molding Capacity*



AVAILABLE IMMEDIATELY!

Let Aico *Cold Molding* provide your plastic handles, knobs, wiring devices, switch bases, covers and similar parts!

Fortunately, there are no serious priority restrictions on Aico Cold Molding materials. We are in a position to put our 25 years of cold molding experience to work for you! Immediately!

Aico Cold Molded Plastics have excellent dielectric qualities, low heat conductivity and are capable of withstanding very high temperatures (600° F. to 1000° F.).

Our engineers will be glad to show you how these materials may apply to your problems.

The parts illustrated, while typical cold molded plastics, do not represent the full range of possibilities obtainable in Aico Cold Molding.

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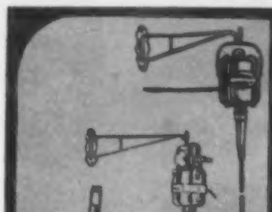
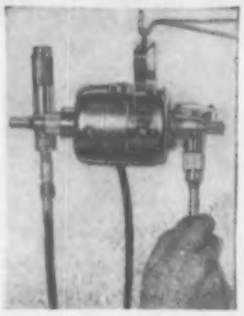


The *Ideal* Grinders for the *Plastic* Field

World's Most Complete Line of Light Flexible Shaft Tools

In these days of "RUSH ALL ORDERS," industry faces gigantic tasks. All too often heavy duty tools are tied-up on small die and mould jobs, and many other miscellaneous operations that the Foredom can do so efficiently. Release your heavy duty equipment for big jobs—and use the Foredom instead. Foredom offers the opportunity for more tools in the shop—so that more jobs can be done—yet at a lower equipment investment.



MODEL 440

Illustrated directly above has the "Bi-Connective" feature which facilitates quickly attaching flexible shaft to geared end for low speeds and to direct-drive end for high speeds. With the additional aid of a foot rheostat which comes with the tool, an extremely wide range of speeds is provided.

Use Foredom...........

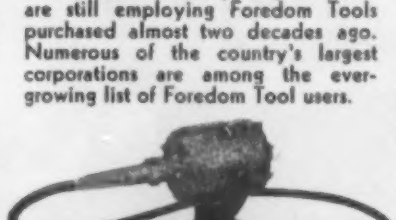
for grinding, milling, polishing, sanding, scratch-brushing, carving, etc., etc., and, of course, for finishing, correcting and touching up dies, molds, etc. In tool die, mold and pattern departments, Foredom Flexible Shaft Tools are indispensable.

MODEL 305

Included in the line are several styles of suspension models which can be hung on any convenient hook or bracket, as well as easily portable bench models as shown at right. Some come with pencil-size hand-pieces for fine, sensitive control. Five hand-piece types are available, all with quick-interchange feature.

Thousands of Users

The merit of Foredom Tools is definitely established by the experience of thousands of users, many of whom are still employing Foredom Tools purchased almost two decades ago. Numerous of the country's largest corporations are among the ever-growing list of Foredom Tool users.



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27 Park Place, New York, N. Y.

Screw Type		Urea Alpha Cellulose	Phenol Wood Flour	Phenol Rag	Phenol Cotton Flock	Acrylate	Cellulose Acetate
		Material					
Cut slot standard thread	Driving torque (lb.-in.)	6	10.7	70	5	5	4
	Stripping torque (lb.-in.)	23	25	35	30	22	13
	Ultimate holding (lbs.)	860	288	900	900	620	340
Rolled flute standard thread	Driving torque (lb.-in.)	9	7	9	6.5	5	3
	Stripping torque (lb.-in.)	25	30	30	25	24	11
	Ultimate holding (lbs.)	529	900	900	950	750	380
Cut slot spaced thread	Driving torque (lb.-in.)	6.7	7.5	7.5	4	3	3
	Stripping torque (lb.-in.)	38	32	28	28	25	15
	Ultimate holding (lbs.)	885	950	1170	1075	868	438
Unslotted spaced thread	Driving torque (lb.-in.)	11.5	12.7	16	11	10	5
	Stripping torque (lb.-in.)	23	27.5	35	33	24	13
	Ultimate holding (lbs.)	1005	940	1175	1090	842	407

TABLE 1.—DRIVING AND STRIPPING TORQUES AND HOLDING POWER OF NO. 8 SCREW IN 1/4-IN. THICK PLASTICS

Thread-producing screws

(*Continued from page 48*) applications is not to be expected. Short screw engagements, especially in the softer plastics, are inclined to strip at low torques, although when properly driven they hold an astonishing load when subjected to direct pull.

Extensive tests have been made to determine driving and stripping torques as well as ultimate holding powers of various types of screws in various kinds of plastics. The results found are not consistently uniform although some general values have been determined. The data accumulated are too voluminous to be incorporated in this article, but a few results are given in Table 1. Torques are given in pound-inches; and to give a better idea of these values it should be kept in mind that the average man exerts a torque of approximately 20 pound-inches when he sets a screw up tight with a screw-driver having a 1-in. diameter handle.

In determining the driving and stripping torques, a special apparatus was used wherein a direct torque reading is obtained while the screw is being turned into the work. The maximum energy required to force the screw into the work is taken as the "driving torque." The "stripping torque" is the energy required to overdrive the screw to the destruction of the threads on the screw or in the plastic.

To determine the holding power of the screw, the Olsen tension testing machine is used and the screw subjected to a direct pull. The force required to pull the screw from the work is measured and known as "ultimate holding."

The above chart shows that when No. 8 screws are driven through 1/4 in. of various kinds of plastics, the load these screws will hold under direct pull varies from 340 to 1175 lbs., depending on the type screw and kind of plastic. The chart also shows that some types of screws drive harder than other types in the same materials. The relation of driving to stripping torques is also indicated.

Conditions of flow of the plastic during its molding cycle have a great effect on its strength properties. Many other factors such as molding temperature and pressure of molding, filler ingredients and their proportions, etc., also have their effect on the strength of the plastic. It is a known fact that the density of some plastics varies throughout a molded piece because of its shape. Often the weakest section occurs just where it is desired to use thread-producing screws. It is, therefore, difficult to determine the best specifications for screw applications without tests on samples.

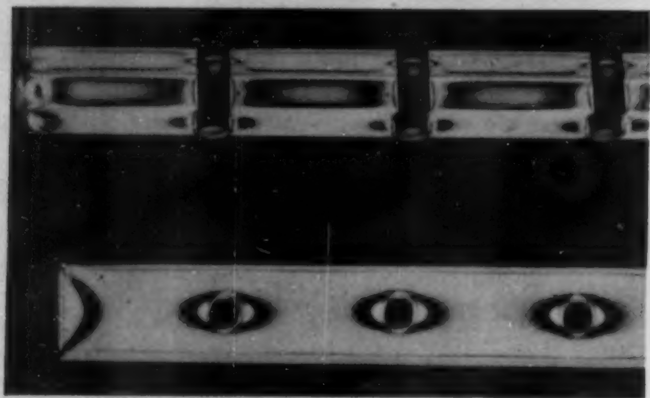
The designer should always bear in mind that long screw engagements result in more secure fastenings especially in the softer plastics. Holes should be cored as deeply as possible and of a diameter consistent with the material, type of screw and length of thread.

During the development of thread-producing screws for use in plastics, the well-known phenomenon of stress-optical sensitivity of certain plastics when analyzed with polarized light was utilized. When an isotropic transparent material having a high stress-optical coefficient is subjected to strain, the material becomes double refractive, and when observed with polarized light an interference fringe pattern becomes visible.

The fringe pattern is composed of isochromatic lines caused by the stresses set up in the plastic. Each fringe represents an increment of stress and, therefore, the more fringes visible, the greater the stresses set up. Where fringes are close together the stresses are concentrated. A fringe pattern having many circular fringes close together around a screw shows that intensive forces are set up which tend to split open the plastic around the screw. The radius of the largest circle in the fringe pattern shows closely the distance away from the screw that the stresses are set up.

Clear phenolic strips approximately 1/2 in. by 5/16 in. were used for test pieces (see Fig. 5). Figure 6 shows a

5



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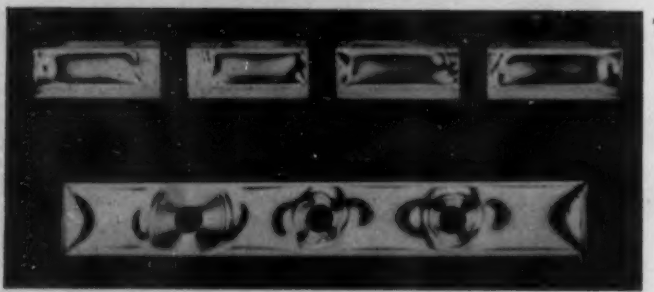

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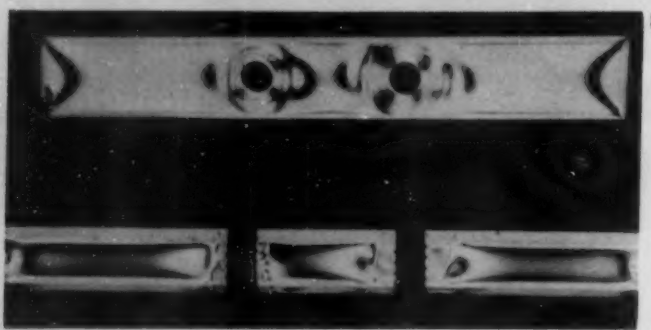

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Clear phenolic strips are used for test pieces (Fig. 5). Figure 6 shows a test piece with three holes before insertion of the screws. Both edge and face views are shown as they appear in polarized light. Figure 7 shows edge and face views of a test piece into which three types of standard thread screws have been driven, using same size holes. Face and edge views of a test piece (Fig. 8) into which thread screws have been driven are shown here

test piece with three holes before the insertion of the screws. Both face and edge views are shown as they appear under polarized light. Some fringe lines around the holes caused by drilling and along the edges and end are visible as can be seen in plate.

Figure 7 shows edge and face views of a test piece into which three types of standard thread screws have been driven, using the same sized holes. The screw heads have been cut off to eliminate the shadow they would cast if they were left on the screws. The fringe patterns on the left were made by a hi-hook (cut slot) screw. The center patterns were made by a multi-flute (rolled slots) screw; and it is interesting to note the effect the five grooves have on the shape of the fringe pattern in the face view. This fringe pattern takes a clover-leaf design.

The right-hand patterns were made by the thread-forming (unslotted) screw. Since these patterns are larger and contain more stress fringes it is an indication, when compared with the patterns formed by the other screws, that the addition of some type of cutting slot in the screw materially reduces the rupturing forces set up. The use of this type of screw would require much greater wall strength to avoid failure of the plastic.

Figure 8 shows face and edge views of a test piece into which spaced thread screws have been driven. The right-hand patterns were made with an unslotted screw, and the left-hand patterns with a screw of the same design but slotted (plastiscrew). Comparing the fringe patterns between these two screws forcibly brings out the advantage of a slot in removing internal strains which might occur.

Many molding ornaments and trim pieces formerly made of zinc die castings are now being made of antimonial-lead. The insertion of thread-producing screws into this material presents problems very similar to those found in plastics due to its softness and ductility. Experience has shown that screws suitable for plastics usually are also suitable in antimonial-lead.

The use of thread-producing screws in plastics is becoming more prevalent every day. Engineers and designers not well versed in the characteristics of these new materials may erroneously expect results equivalent to those obtained in metal applications. If they know the holding power of properly applied screws they will realize that these give ample strength with a high factor of safety to the application.

This sometimes is not sufficient, however. The information must be given to the shop or assembly line so that these men learn how to insert the screws properly. Most failures result from over-driving the screws. Excess driving torques result in stripped holes or split pieces. An assembler used to driving screws into metals is inclined to apply too much torque when driving screws into plastics. Screws in plastics give satisfactory holding power at considerably less torque than in metals; and because they fail at lower torques the impression is occasionally created that they are not holding sufficiently.

Advances in plastics—1941

(*Continued from page 67*) in industrial applications based on the material's resistance to oils and other common chemicals. Fields of application include chemical processing, rayon, automotive, dairy and national defense.

Cellulose esters

by BJORN ANDERSEN*

PRODUCTION of cellulose ester plastics during the year 1941 has shown an increase of approximately 50 percent over the previous year. It is estimated from the Bureau of Census figures that the production of cellulose nitrate sheets, rods and tubes in 1941 will amount to 16,600,000 lbs., an increase of roughly 40 percent over the 1940 production. Cellulose acetate sheets, rods and tubes showed a decrease of approximately 27 percent compared to the 1940 production, which was close to 9,000,000 lbs. The main reason for this decline is the elimination of cellulose acetate safety glass sheet production from the 1941 Bureau of Census figures. This action was logical because another plastic sheeting has to a major degree replaced cellulose acetate sheets in the production of safety glass.

The production of cellulose ester molding powders during 1940 amounted approximately to 15,000,000 lbs., while the figure for 1941 is estimated at 30,000,000 lbs.—an increase of 100 percent. The cellulose ester molding powders comprise cellulose acetate and cellulose acetate butyrate. From the above figures will be noted an increase in the production of cellulose ester plastics of more than 17,000,000 lbs. during the year 1941 as compared to 1940. In this figure is not included the large amount of cellulose esters being used in the form of continuous length film and foil in thicknesses varying from .0005 in. to .020 in. Excluding the photographic film bases, which are all made from cellulose ester plastics, such continuous length foil and film serve a multitude of applications, of which the dominating ones are in the electrical industry and in the packaging and container field, as well as in a number of important national defense applications. Industry production figures are not available on this type of cellulose ester product, but the year 1941 has seen a healthy growth.

* Plastics Div., Celanese Corp. of America, formerly Celluloid Corp.

Line-up of screw-type continuous wet extrusion machines showing the cut-off device at the end of the conveyor

PHOTO, COURTESY CELANESE CELLULOID CORP.

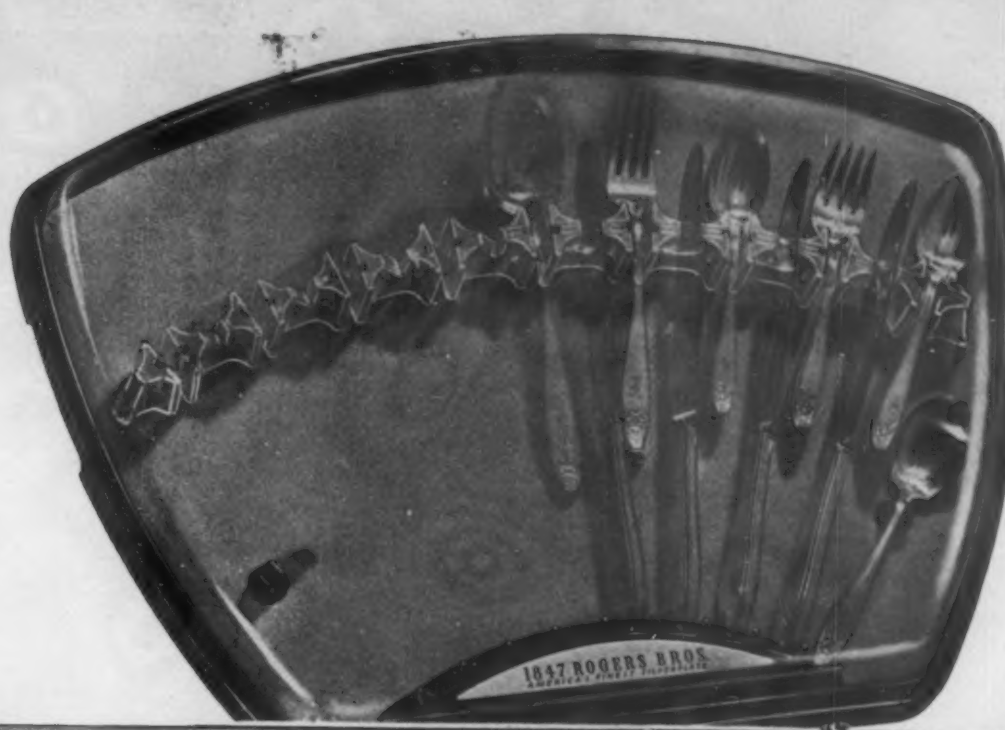
The cellulose ester molding powders are capable of replacing metals in many articles and play an important part in the national defense picture by alleviating the metal shortage Many articles made by the zinc die-casting process have been made in these plastics. A most notable example is the telephone hand-set base and receiver, to which application the cellulose ester molding powders have added beauty, strength and permanence. Other important metal replacements are found in refrigerator parts, such as corner pieces, shelf studs, bezels, latch handles, etc. In vacuum cleaners metal has been replaced for such parts as funnels and nozzles, intake flange, housings and louvers, as well as handles. Metals have been replaced in many other articles such as brackets, hooks and buckles. Demand for metal replacements and development of special formulations for the purpose have given tremendous impetus to extrusion molding[1] of cellulose ester molding powders into continuous strips of many different profiles for a great variety of applications. Extruded strips are used for fastening and joining wall boards, for decorative molding, for floor covering trim, for table trim, for weather stripping in doors and windows and for many other applications where metal stripping has been used. The current metal shortage has accelerated the entry and use of plastic products in several of the above-mentioned applications, but we believe it equally true that many of them will retain the plastics when the metal shortage is over, because of the advantages offered, such as eye appeal, light weight, non-corrosivity and ease of handling and fabricating—not to mention an unlimited color field.

National defense has also directly played a big part in the broadening use of cellulose ester plastics during the past year, and will probably be a still bigger factor during 1942. There are many important defense applications, of which we can mention injection-molded lenses[2] for training gas masks, eye pieces for civilian masks, injection-molded gas mask parts, e.g., valve guards and Y tubes, light filters for blackout lights, transparent sheets for certain types of airplane cockpit enclosures, shields for inspection windows, etc. The covering of airplane propeller blades with cellulose acetate or cellulose nitrate sheets is not a new application, but is of increasing importance during the present emergency.

Applications for civilian use continue to grow. Automobile hardware[3] is not new, but still more molded parts were used in 1941 models than in the previous year. Light diffusing screens to reduce the glare and brightness of fluorescent lamps have been introduced. The screens have high diffusing power and transmit a very high percentage of the light emanating from the light source. Dome shapes for lighting fixtures can be drawn from diffusing sheets by deep drawing process. Somewhat similar to the fluorescent lamp screen is the rear projection screen, which can be used in coin-operated motion picture machines, micro-film projectors, television machines and other applications of image projection where the audience and projector are on opposite sides of the screen. The screens are of cellulose acetate sheet stock with a high diffusing surface on one side, and a viewing surface on the other side that eliminates light reflections from external sources.

Novel displays and decorative effects are made from cellulose acetate plastics containing fluorescent material which is activated by ultraviolet light. Under the ultraviolet radiation of the so-called black light these materials glow in the dark with unusual effect.

A spiral wound tubing of thin cellulose acetate film has been



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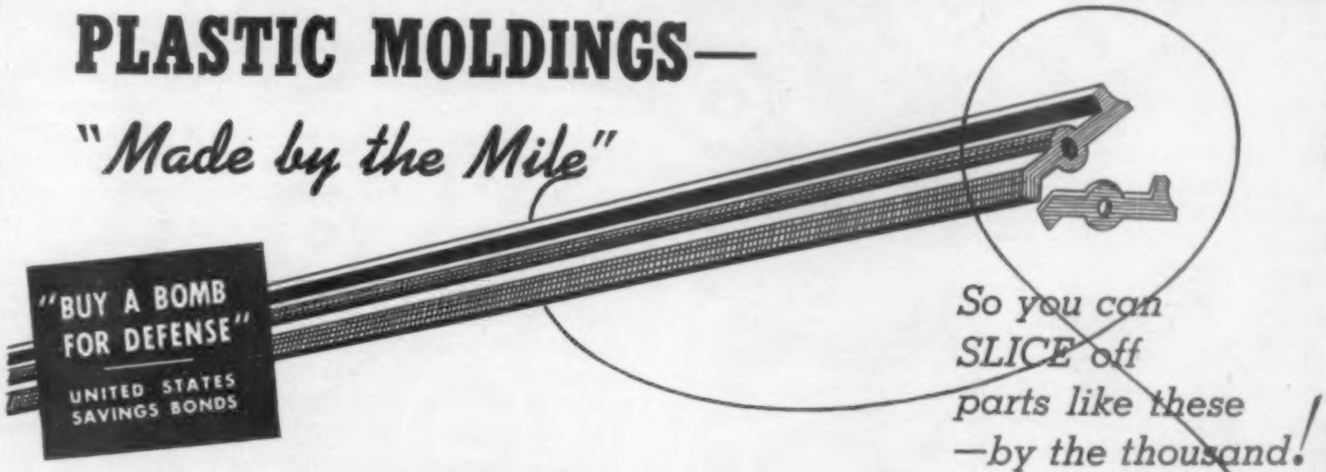

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developed for the electrical industry. It is produced in round, oval and square shapes of various sizes in continuous lengths that can be cut to required lengths as it emerges from the winder.

The cellulose ester plastic industry in common with many others is threatened with curtailed supplies of raw materials, particularly plasticizers. If the high level of production is to be maintained and increased, new plasticizers more readily available will have to be found. The patent literature[4] during the year reveals a few new plasticizers and others are under development. From the present necessity many interesting and valuable compounds may result.

It is of interest to note that the cellulose nitrate plastic, the original plastic born approximately 70 years ago, has shown a growth during 1941 of 40 percent over the 1940 production. One reason for this is the important part this plastic plays in national defense. It is used in various types of ammunition, such as powder containers, cartridge wads, etc. The elimination of foreign imports, especially from Japan and Germany of the so-called blown toys,[5] e.g., dolls, rattles, animals, etc., also accounts for a considerable portion of the increased production. Screw driver handles made from cellulose nitrate rod stock are continually growing in popularity.

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Cellulose ethers

by SHAILER L. BASS and ARTHUR E. YOUNG*

THE rising tide of activity in the national defense, with its unprecedented demands for all plastic and film forming materials, compelled manufacturers of ethylcellulose to put users on a quota basis during the year.[1] Ethylcellulose production in 1941 has advanced from 300,000 to 400,000 lbs. per month, but the large increase in requirements cannot be supplied from present manufacturing capacity. A large portion of the increased demand resulted from shortages in other normally available quick-drying finishing materials. In addition, both military and civilian uses are requiring increasing quantities of ethylcellulose in plastics, particularly for extrusion and injection molding.

Extruded ethylcellulose received two awards in the 1941 MODERN PLASTICS COMPETITION.[2] One was for the use of extruded trim, binding and edging strips to replace strategic aluminum for linoleum topped sinks and tables. Advantage was taken of the dimensional stability and toughness of ethylcellulose extruded sections to add glowing color to this interior decorative and functional use. The other was a novel decorative roll blind fabricated of extruded translucent strips of ethylcellulose plastic in pastel colors. Extruded ethylcellulose was chosen for its toughness, low flammability, shock resistance at low temperatures and its stability to light and moisture.

Extruding tubing of ethylcellulose received attention from the medical viewpoint[3] and was said to make excellent catheters because of its inertness, thermoplasticity and stability to sterilizing conditions. A sterilizable adhesive tape with a backing coating of plasticized cellulose ether was also described.[4]

* Cellulose Products Div., Dow Chemical Co.

PHOTO, COURTESY DOW CHEMICAL CO.

Solvents recovered during the manufacture of ethyl cellulose are stored in these huge tanks

Extrusion wire coating with ethylcellulose insulating compositions was the subject of two patents granted during the year. One claims broadly an electrical conductor with a glossy sheath of an extruded cellulose derivative composition, non-cracking at zero deg. C.[5] Also claimed is the method of insulating wire by extruding the cellulosic plastic at a temperature such that it has a viscosity of less than 600 poises. This temperature range is said to be 200–275 deg. C. for ethylcellulose plastics. The specification infers that coatings which are non-cracking at zero deg. C. result from any cellulose ether composition simply by extruding in the above temperature range.

The other extrusion wire coating patent deals with compositions of ethylcellulose and mineral oil as the insulating sheath.[6] The necessity of extruding at a high temperature is pointed out. This temperature is said to be one high enough to fuse the plastic and is recognized by testing the flexibility of the coating when bent sharply. The patent teaches that extrusion temperature is dependent upon the composition of the plastic and upon the ethoxyl content of the ethylcellulose used.

Foremost among the lacquer applications in defense uses was said to be ethylcellulose coatings for shell lacquers, plywood adhesives and aircraft ignition cables.[1] The value of ethylcellulose not only as an insulator but also as a protection for cellulose against heat was recognized in an insulated wire constructed with an inner layer of regenerated cellulose coated with ethylcellulose.[7] An improved method of molding acetate sheeting on aircraft propellers was claimed in which a coating of ethylcellulose on the enveloping surfaces prevented sticking when fluid pressure was applied.[8] An improved stretchable masking tape also uses an ethylcellulose backing coating to prevent sticking.[9] Ethylcellulose coatings containing heat convertible urea resins may be applied to unvul-

canized rubber, and on vulcanization become solvent resistant.[10]

Shortage of tung oil led to an examination of the softer drying oils for Federal Specification varnishes. Ethylcellulose was suggested for use in these substitute varnishes to offset after-tack. Methods of incorporating ethylcellulose during the cooking procedure utilize catalytic amounts of lead or zinc salts to obtain improved compatibility.[11] Or, ethylcellulose can be cooked into the drying oil directly to yield bodied oils soluble in naphthas and drying with increased film strength and reduced tackiness.[12] Ester gum spirit varnishes toughened with small proportions of ethylcellulose were recommended for traffic paints in England.[13]

In the textile field, shortage of vat dyestuffs lends interest to the process for coloring fabrics with a pigmented emulsion containing ethylcellulose as part of the binder composition.[14] Viscous alcoholic solutions of ethylcellulose may be printed on fabrics or paper and used as sympathetic inks, invisible when dry but visible when the material is wetted.[15]

Fabrics may be stiffened by impregnating with ethylcellulose lacquer emulsions to pick up 5 to 40 percent of the fabric weight. After drying, the fabric is hot calendered to incipient fusion of the deposited ethylcellulose.[16] Another method for applying cellulose ethers to fabrics involves hot calendering the plastic resulting from swelling the cellulose derivative with a plasticizer.[17] Still another is illustrated in the preparation of a box toe fabric by indurating flannel with a melted composition of ethylcellulose, plasticizer and rosin.[18]

In the field of paper coatings, grease-proofing of paper with ethylcellulose was described[19] and a method of continuously coating while avoiding edge beads was claimed.[20] A method of setting ink films at high printing speeds without the use of high temperatures utilizes a spray of a high viscosity type of ethylcellulose.[21] An improved transfer, particularly for imitating wood paneling designs, has several layers of ethylcellulose, each contributing a portion of the grain design.[22]

Low viscosity ethylcellulose hot melt compositions for solventless coating of paper on waxing machines were described.[23] Hot melt printing inks for application at 150–300 deg. F. were claimed for pigmented wax compositions containing up to 10 percent dissolved cellulose ether.[24] Granular products suitable for making hot melts were said to be obtained by absorbing melted waxes in a hot aqueous suspension of freshly precipitated ethylcellulose.[25]

A novel method of forming thermoplastic sheeting from a solvent-free plastic appeared.[26] The plastic is extruded as a translucent sheet which becomes clear and transparent by hot rolling without appreciable tension.

Manufacturing improvements during the year include a two-stage ethylation process,[27] preparation of alkali cellulose in the presence of a diluent,[28] manufacturing process for high viscosity cellulose ethers,[29] recovering ethers from reaction mixtures[30,31] and bleaching.[32]

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Portrait of an industry

(*Continued from page 39*) by manufacturers of machine tools, it has become difficult to secure prompt delivery, even though new equipment required for plastic manufacture has been covered by priorities.

The National Machine Tool Builders Association recently announced that the value of shipments rose to $77,200,000 in October 1941, as compared to $49,000,000 in the same month of 1940. The Association said further that the machine-tool industry will in all probability exceed its previously announced goal of $750,000,000 for 1941. Even in view of these increases, it is a foregone conclusion that until all plants making matériel are properly equipped with machine tools, it will be difficult to obtain plastic presses or similar special equipment for commercial manufacturing of plastics products.

It has been customary for the builders of standard lines of presses to run them through in economical production lots in advance of actual orders. Such a procedure is now obsolete because raw materials are not available without priorities, and practically all such equipment must today be ordered with priority ratings. Due to the fact that a longer interval is now required to obtain special steels or other critical materials, deliveries are delayed in some cases as much as 8 or 10 months or even longer.

Regardless of these conditions, it is pleasing to know that the majority of the plastics machinery producers are going ahead with development work, and constant improvements may be looked for in all equipment of this kind. The trend of the injection molding machines is definitely toward larger capacities. Whereas a 6-oz. machine was considered large a year or so ago, standard single-nozzle machines are now being offered in 12-, 16- and even 22-oz. capacities.

Automatic compression molding presses are being further developed and will handle larger items more satisfactorily. Extrusion machines, the latest type of equipment in the plastics field, are very much in demand, although, due to the limited use of extrusion moldings by the military, it is difficult to secure materials for fabrication.

New plastic press equipment will be available if sufficiently high priorities accompany orders. On the other hand, there will be greater delays in securing such equipment, even with priorities, because of the length of time required to procure the necessary critical metals.

Granted that there will be no appreciable increase in amounts of materials available for plastics production in 1942, molders and fabricators both of thermosetting and of thermoplastic materials should watch developments carefully and govern their actions accordingly. Everything possible should be done to increase the percentage of war business, and to solicit work in those fields insuring receipt of raw materials on a strict classification basis.

Resin for friction material

(*Continued from page 41*) by mushrooming, its effective life is, of course, greatly reduced. This pressure of brake application varies for the average driver of an automobile from a few pounds up to approximately one hundred pounds of pedal effort. With the use of air brakes and in various industrial applications, however, the deforming load is greatly increased over that for the passenger car, and the tendency to mushroom the friction element comes into play. This latter tendency has been adequately met through the use of thermosetting resins.

Improved structural strength: Resistance to shear is important in order to prevent enlargement of rivet holes due to the moment of force which thrusts a friction material in service against the rivets holding it. Resistance to ply separation in certain cases is a consideration. Ability to withstand without breakage the centrifugal force developed, for example, by rapidly rotating a clutch facing at an elevated temperature, is a necessity. Much headway has been made in meeting such requirements as these, and frequently through the judicious use of synthetic plastics.

TABLE I—Wearing Qualities of Friction Material

Average Operating Temperature	*Rate of Wear (Cu. In./H.p. Hr.)* A	B
160° F.	.0018	.0012
350° F.	.0046	.0029
400° F.	.0073	.0066
800° F.	.384	.124
1000° F.	...*	.290

* No observations on wear due to physical disintegration of sample.
A Material containing no synthetic plastic.
B Material containing a full complement of thermosetting resin

Along with the development of friction materials there has been a steady parallel development of equipment for testing them. Today there are large laboratories, equipped with much highly specialized and expensive test apparatus and manned with trained technicians, devoted entirely to the evaluation of friction materials. Fleets of test vehicles are operated year in and year out, determining on a practical basis the relative values of the materials which the friction materials industry has to offer. Testing is a vital phase of friction materials development, and the engineers who have constructed test-machines are to be congratulated for the important part they have played in bringing friction materials to their present state of perfection.

Application of resin-bonded friction materials

Both liquid and powdered thermosetting resins have their special applications in brake-lining materials. The kind of process used to fabricate the friction material is often the deciding factor in determining which of these types should be used.

Based on structural features, there are three general classes of friction materials:

1. Woven products
2. Rubberized fabric products
3. Molded products

Manufacture of the first two types involves the use of asbestos textile products; such, however, is not the case in fabricating the conventional molded types.

(*Please turn to next page*)

CLASSIFIED

WANTED: PLASTIC SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

WANTED: Injection Molding Acetate Scrap or Rejects in any form, including Styrene, Acrylic, Butyrate, Vinyl Resin Scrap materials. Submit samples and details of quantites, grades and colors for our quotation. Reply Box 508, Modern Plastics.

WANTED: Stokes Rotary Tablet Machine, Type DD, 500 to 700 Tablets per minute, 5/8″ to 1-1/16″ Tablets. 15 x 15″ Watson-Stillman Transforming Press with Pushbacks and Ejectors. Reply Box 512, Modern Plastics.

FOR SALE: 1—400 Ton Horiz. Hydraulic Extrusion Press. 1—Hydraulic Scrap Baler, 80 Ton, 6½″ Ram, 90″ Stroke, 5000 lbs. per sq. in. 2—W. & P. Mixers, Size 15. 75 ft. Link Belt Conveyor, 36″ wide. Large stocks of Hydraulic Presses, Pumps & Accumulators, Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizers, Tumbling Barrels, Gas Boilers, etc. Send for Bulletins #156 and #138, and L-17. We also buy your surplus machinery for cash. Reply Box 439, Modern Plastics.

WANTED: Stainless Steel or Nickel Kettle, Vacuum Pan, Hydraulic Press, Preform Machine and Mixer. Reply Box 275, Modern Plastics. No dealers.

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CHEMIST OR CHEMICAL ENGINEER, American, about 30 years of age, with high grade training and several years' experience in resin manufacture, phenolics preferred, for development of adhesives and binders together with intermediates required. An unusual opportunity in a new field. Location Middle West and West Coast. Submit details of education, experience, personal data, salary required, and include photograph. Reply Box 497, Modern Plastics.

WANTED: Molding compound technician or chemist. Must have practical experience making hot molded asphalt, shellac and synthetic molding compounds. Reply Box 507, Modern Plastics.

WANTED—Injection molding machines in all sizes. Reply Box 509, Modern Plastics.

PLASTIC MATERIAL MANUFACTURER desires sales service man for work in the East. Some knowledge of impact materials desirable. Reply Box 510, Modern Plastics.

VENEER AND PLYWOOD PLASTIC SPECIALIST with executive ability, thoroughly experienced abroad in synthetic resin molding with hydraulic presses and rubber bag, seeks contact for development or employment with aviation or laminating firm. Reply Box 511, Modern Plastics.

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Woven linings supplied in multiple-ply construction up to thicknesses approximating $1^1/_4$ in. lend themselves to impregnation processes. Substantial quantities of thermosetting resins along with other materials are utilized in this connection by the brake-lining industry. A baking period to cure the impregnated lining is, of course, necessary.

Rubberized fabric products are, in a sense, also impregnated. In this case the impregnant consists of a rubber compound which is brought into intimate contact with the asbestos fabric by friction coating, using a rubber calender. Older methods actually involved the application of a rubber cement to the fabric, which was then allowed to dry. Such rubberized fabrics are then plied to give the desired thickness, and are cured under heat and pressure to consolidate and vulcanize the product. Whereas rubber was used almost exclusively as the plastic material in the type of lining made a few years ago, today a number of synthetic resinous products are used partially to replace the rubber.

A wide variety of friction materials is included in the group designated as molded products. By reverting again to the structure of the material, which reflects its mode of manufacture, it appears logical to subdivide this group further in accordance with the following plan:

- Molded Products
  - Laminated
    - Sheeter Products
    - Millboard Products
  - Unlaminated
    - Wet Process
      - Extruded Products
      - Roll-Formed Products
    - Dry Process
      - Dry Molded Products

Sheeter products are formed from a mixture which includes asbestos fiber and rubber cement, associated with other synthetic plastics. This cemented mixture is brought into contact with a heated, rotating cylinder; and with each rotation of the cylinder a new layer or lamination of stock is formed as the solvent in the freshly deposited film evaporates. The operation is continued until an adequate thickness of stock has been formed on the heated cylinder, whereupon the stock is removed and consolidated under heat and pressure to give a cured friction element.

Extruded and roll-formed products are formed from stocks similar in many respects to these used to make sheeter products. As the names indicate, these respective products are actually formed (1) by extruding soft cemented stock by means of pressure through an orifice to give a ribbon-like length of uncured friction material, and (2) by fabricating stock of dough-like consistency into a sheet by passing it between adjacent rolls. After cutting and trimming operations have been carried out on the base products so formed, they are subjected to drying and curing in the conventional manner.

Millboard products are prepared from asbestos millboard which has been saturated in a suitable impregnant and then baked. This type of material is becoming obsolescent and its usefulness today is relatively limited.

In contrast to the molded products described above, dry molded friction materials represent possibilities for the simplest and fullest use of thermosetting resins. In this type of fabrication, the various ingredients are thoroughly mixed while in a completely dry state. Powdered resins naturally fit into this procedure. The thoroughly mixed dry stock is then either introduced directly into a deep cavity mold and cured, or it may be subjected to preforming operations prior

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to its cure in shallow cavity molds. It is noteworthy that the trend, particularly with regard to brake blocks, has in recent years been definitely in favor of the dry molded type of friction material.

It is desirable to have a relatively quick curing cycle, compatible with proper flow characteristics of the stock during cure; and freedom from blistering is a primary consideration, particularly with respect to clutch members and brake blocks of large cross section. The dry molded type of product offers definite advantages along these lines. With the wide variety of powdered resins available for use as binders, and the numerous other polymerized synthetic plastics which may be added in association with the powdered resins in order to develop the desired frictional characteristics, it is small wonder that dry molded products possess a flexibility of formulation and a simplicity of manufacture that augurs well for the continued use of synthetic plastics in ever-increasing amounts by the friction-materials industry.

The eyes have it

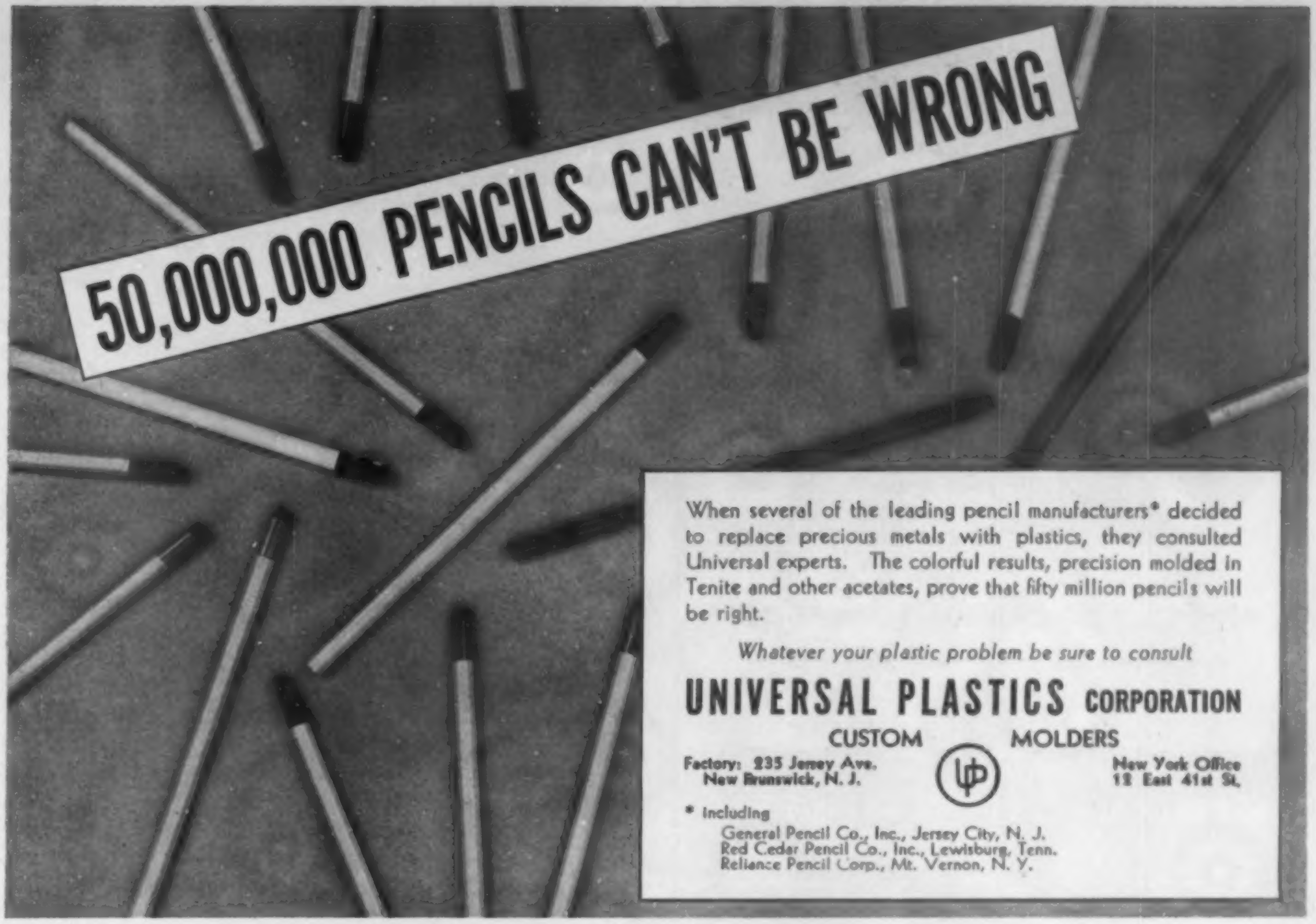
(*Continued from page 46*) to harmonize with a plastic frame. Another used plastic eyeframes in a cosmetics show, and a third advised on the selection of the right color for particular skin tones. Becomingly shaped lenses, oddly shaped rims and smart-colored frames are what women have waited for in eyeglasses.

Although unusual shapes and bright colors for frames have been part of a concerted promotion to relate eyewear with clothes for women, frames for men and children have also changed radically. It is estimated that 67 million people in the United States alone wear glasses. Of that number, seven million are children. In other words, two thirds of all men and women in the United States wear glasses and one fifth of all the children. The plastics industry has taken advantage of this huge market and, by various methods of fabrication, made plastic frames which enable modern eyeglasses to meet the requirements of style and color harmony.

Fabrication of modern optical frames requires the skill of designers, optical engineers, precision craftsmen of long experience as well as a number of other workers trained in precision operations. Hairline accuracy is essential to the quality and appearance of the finished frame. It takes 44 operations to complete the quality spectacle frame. The major operations are, briefly, as follows:

Plastic sheets are cut into working units of 20 in. by 5 in. The pattern for a particular design is carefully marked on a strip. This may be placed on top of four other strips and five may be cut at one time, but no more than five, without loss of accuracy. A lathe turning operation then cuts two eye cavities of exact size into the plastic blank. If the frame is an odd shape, these cavities—eyewires, they are called in the trade—must be skillfully jigsawed out. Then the strip is heated and the bridge formed by hand pressure applied against the sides of the frame. Each eyewire is then grooved so that the lenses will be held tightly in place. The next step is sandpapering, frazing, carving and polishing. After this. the frame begins to take on the attractive form planned by the designer. Holes must then be carefully drilled, and slots cut in the end pieces to prepare them for the attachment of metal hinges and temples.

For fine quality optical frames, temples are usually made with reinforced wire core which facilitates their adjustment when fitting and increases their strength. Two strips of



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plastic are grooved to permit the wire core to be placed between them. Both grooved surfaces are covered with a solvent cement and are fused together into one solid seamless piece by sustained pressure. The resulting wire-cored temple is then submitted to the same process of washing, sandpapering, frazing, and polishing as the frame front. The polishing operations in which are utilized various clays and rouges are an essential factor in the quality of the finished frame, because it takes long experience to know when a frame is finally polished to the high finish which endows it with long life and enduring sparkle.

According to the figures compiled from membership reports by the Optical Manufacturers Association, there was an increase in sales of plastic frames during 1940 over the previous year of 11.73 percent. For the first nine months of 1941 there is recorded a further increase over 1940 of 40.9 percent. These increases are well ahead of the general increase registered for the entire industry.

Plastic frames are designed for many uses. Lorgnettes for casual wear or the opera; specolettes for reading menus, so constructed with hinges that they fold compactly together and fit into a change purse; Oxfords, and plastic frames with gold filled bridge and temples, for formal wear. Sun-glass frames are also fabricated from nitrocellulose sheet stock in a variety of colors. Lenses of plastic are also coming into the optical field, but this development is still in its infancy.

The war will no doubt affect availability of material for the novelty applications, but simple frames will probably be made —and an increased demand for plastic frames is indicated because of metal shortages. Furthermore, the initial stimulation to the industry as a result of the fashion-styled frames will probably carry over as the public turns to the more conservative styles.

Credits—Materials: Pyralin; Nitron for zyl-plastic frames. Designer: Louis Grossman. Manufacturer: Optical Products Corporation

Plastics in British aircraft

(*Continued from page 82*) electrical properties: a power factor $^1/_3$ that of a similar type of phenolic material, water absorption less than $^1/_2$ that of a similar board impregnated with phenolic.

It might now be asked what reaction there has been to this greatly increased use of plastics in British aircraft, both fighters and bombers. There is no possible doubt that this has been very favorable, and air crews are becoming increasingly plastics minded. You no longer hear that dreadful term "composition" or that equally libelous appellation "substitute" applied to plastic moldings. Instead, technical and proprietary names are used with glib familiarity. The name "Perspex," for instance, is applied ad lib. by pilots to any kind of organic glass [British term for acrylic sheet] British or Nazi.

As mentioned earlier in this article, the thermoplastics are the materials receiving premier consideration for such essential purposes as turrets, hoods, windows, fairings, coverings of air screws (Schwarz), bomb doors, etc.; for all transparent moldings or formed pieces; and also for fillets for tailplanes, fins and wing roots, spats, scoops, slats, ducts, air chutes, ding stowage boxes, pilot seats, etc., molded of black sheet material. The phenolic laminated and molded applications include pulleys, gears, hand wheels, roots of wooden blades, collars for hydromatic airscrews, instrument boards and brackets, switches, electrical and radio parts. To catalog the entire applications would be tiresome, even if it were permitted, but sufficient has been said to show that plastics are first-line materials for the most important industry in the world. (*The London letter follows on the next page*)

London Letter

THE importance attached by the British Government to the plastics industry is well illustrated by the fact that special training centers have now been opened by the Ministry of Labour and National Service to train moldmakers. The instruction, which is open to both men and women, is short but intensive, and the centers are designed to feed the tool-making side of the plastics industry with trained personnel in sufficient numbers to make good the loss of staff by migrations into the armament industries and entry into the fighting services. A small working wage, sufficient for board and lodging, is paid by the Government to all trainees during the course of instruction. As soon as they have qualified as skilled toolmakers, they are posted to the various firms on the waiting list.

Considerable interest is now being shown in the use of the dry powder pistol for depositing thermoplastics on metal and other surfaces, and metals on thermosetting and even thermoplastic surfaces. The thermoplastic material of any kind is passed through the flame in a fine powder form and produces a smooth, homogeneous coating which, being freed from oil or solvents of any kind, is not subject to oxidation. By means of the Schori Process polymerized shellac by itself and in combination with such fillers as mica or metals, has been sprayed onto the surfaces and some amazing results obtained. Phenol formaldehyde resins in a special form, cardolite, ebonite and synthetic rubber have all been used with considerable success. It is suggested that by the use of the Schori Process cellulose acetate can be greatly improved by depositing on its surface a coating of dry and unplasticized polyvinyl resin. This would effectively seal the surface and prevent permeation by moisture.

British-produced ethyl cellulose is now being utilized for many of the applications formerly reserved for cellulose acetate, particularly for specialized uses where non-brittleness at low temperatures (down to -50 deg. C.), and low water absorption, high heat stability and freedom from shrinkage on exposure are required. The material is available to British users in sheets 54 in. by 24 in. and in thickness from $^{5}/_{1000}$ in. upward, and also in extruded rods and tubes.

Dr. N. A. de Bruyne, the brilliant research worker and director of Aero Research Ltd., has just announced the development of a new adhesive capable of joining phenol formaldehyde or urea formaldehyde moldings or laminated sheet with such efficiency that the shear strength of the joint usually exceeds that of the parent material. The new adhesive Ardux has been in use for over two years but has only recently been released from the Secret List. Of the greatest interest to molders is the use of this adhesive for securing metal inserts into moldings and laminated sheets if the root end of the metal insert is knurled. Ardux is the suspension of a powder in a highly reactive synthetic resin. It is applied to the surfaces to be joined, which are then left for a few minutes to become tacky. The joint is then heated to not less than 140 deg. C. At 155 deg. C., Ardux will set in six minutes. Two types of the material are available, Ardux 1 and 2.

As a tailpiece, a word about the new plastic petrol lighter is of interest. The British Board of Trade is encouraging the production of these, which are tax free, to overcome the shortage of matches (housewives and smokers are rationed to 1 or 2 boxes a week). Difficulty so far experienced is that the phenol formaldehyde resin begins to bleed after contact with petrol for a few days. The writer understands that a special asbestos-filled phenolic resin is so far providing the most satisfactory in the early trials of this much publicized lighter. (*Mailed December 2, 1941, by Mrs. John S. Trevor.*)

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